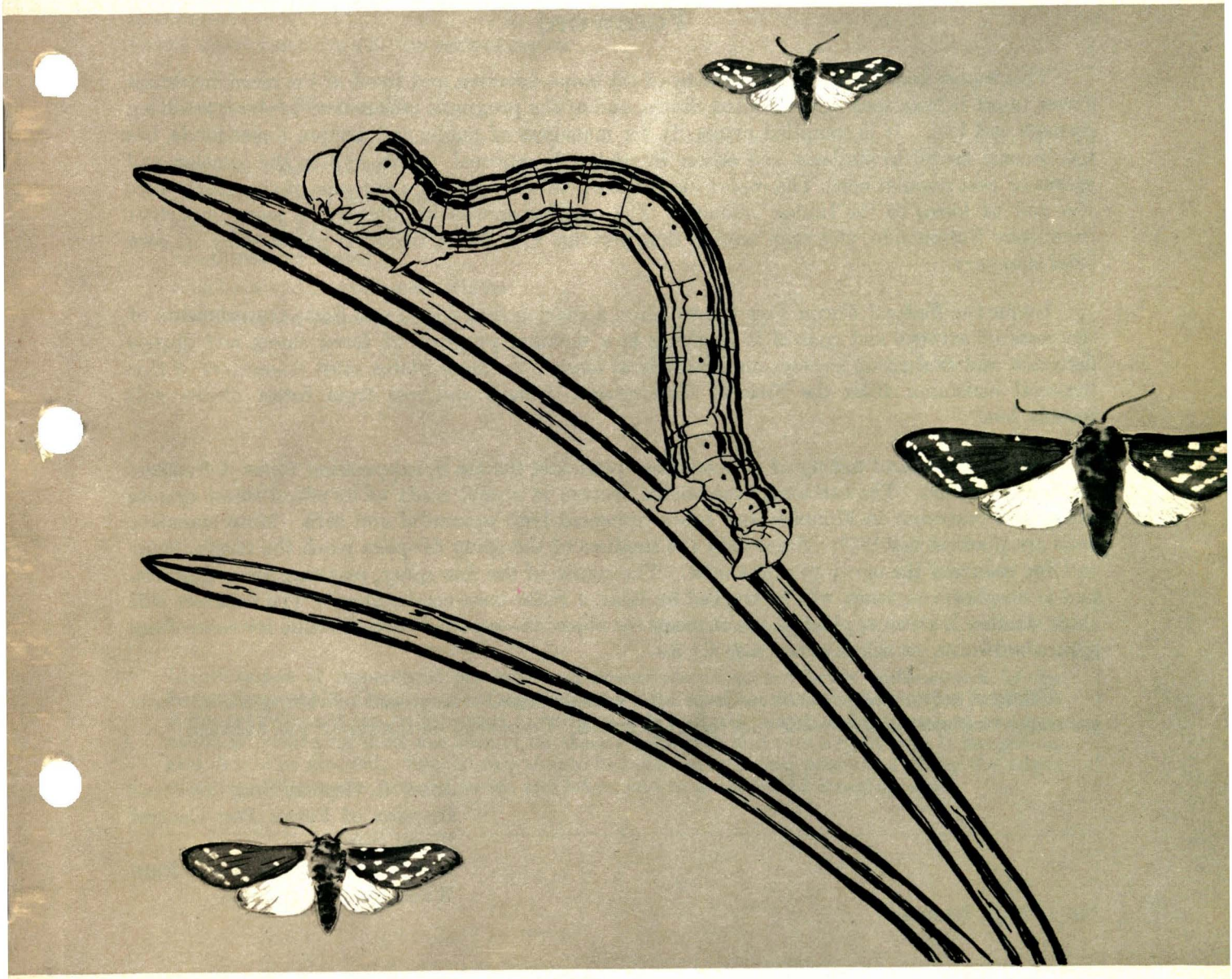
SB
761.U742
S72
1966

Ips beetles
Melanoma sp.

FOREST INSECT CONDITIONS

IN THE UNITED STATES 1966



FOREST SERVICE
U.S. DEPARTMENT OF AGRICULTURE

Foreword

This report is the 18th annual account of the scope, severity, and trend of the more important forest insect infestations in the United States, and of the programs undertaken to check resulting damage and loss. It is compiled primarily for managers of public and private forest lands, but has become useful to students and others interested in outbreak trends and in the location and extent of pest populations. The report also makes possible a greater awareness of the insect problem and of losses to the timber resource. The opening section highlights the more important conditions Nationwide, and each section that pertains to a forest region is prefaced by its own brief summary.

Under the Federal Forest Pest Control Act, a sharing by Federal and State Governments of the costs of surveys and control is resulting in a stronger program of forest insect and disease detection and evaluation surveys on non-Federal lands. As more States avail themselves of this financial assistance from the Federal Government, damage and loss from forest insects will become less.

The screening and testing of nonpersistent pesticides for use in suppressing forest defoliators continued in 1966. The carbamate insecticide Zectran in a pilot study of its effectiveness against the spruce budworm in Montana and Idaho appeared both successful and safe. More extensive tests are planned for 1967. Since only the smallest of the spray droplets reach the target, plans call for reducing the spray to a fine mist. The course of the fine spray, resulting from diffusion and atmospheric currents, will be tracked by lidar, a radar-laser combination. The field test will show whether Zectran applied as a mist meets the objective—an effective insecticide for controlling spruce budworm, yet selective and safe for use.

Grateful acknowledgment is made to all Federal, State, county, and private agencies whose assistance and cooperation made this report possible. Comments on the report are welcome.

JOHN R. GEORGE, *Staff Assistant*
Division of Forest Pest Control
Forest Service
U.S. Department of Agriculture
Washington, D.C. 20250

Contents

	Page
Foreword	2
Highlights	4
Forest insect conditions in the various regions	7
Alaska	7
Oregon and Washington	9
California	12
Intermountain States	16
Northern Rocky Mountains	21
Central Rocky Mountains	24
Southwestern States	27
Southern and Southeastern States	31
Northeastern States	37
Index	40

Identification of commercial products and insecticides does not imply endorsement by the Forest Service, U.S. Department of Agriculture. Also, the Forest Service warns that pesticides if improperly used can be injurious to humans, fish, and wildlife; that the directions and precautions governing their use should be closely followed; and that overdosing is dangerous and should be avoided. Special care should be taken in applying pesticides along the edges of rivers and streams, around ponds and lakes, and in grazing and foraging areas.

Issued April 1967

Highlights

Situation in the Western States

Bark beetle infestations, including several major ones, were dominant among the many insect problems affecting the forest resources in the Western United States. Easily most important were the chronic epidemics of mountain pine beetle in stands of lodgepole pine on the Targhee National Forest, Idaho, and on the Teton National Forest and Teton National Park, Wyo. However, despite the widespread infestations and serious depletion of the resource that occurred in 1966 and is predicted to continue in 1967, there is some evidence there may be a general decline from peak levels of populations.

The mountain pine beetle was a major pest elsewhere in the West. For example, serious infestations occurred in many stands of lodgepole pine in eastern Oregon; they took a heavy toll in second-growth ponderosa pine, also in eastern Oregon; they seriously depleted the volume of mature western white pine in parts of Montana and northern Idaho; and they killed many ponderosa pines previously top-killed by ips. The same insect, referred to as the Black Hills beetle in the Central Rocky Mountains, killed many ponderosa pine on State and private lands in the Black Hills of South Dakota, and on the San Juan National Forest, Colo.; it killed many limber pines on the Shoshone National Forest, Wyo.

On a regional basis, except for the serious bark beetle situation, insect problems were numerous but much less serious than during the past few years.

The situation in Alaska remained much the same as in 1965. A leaf-tier skeletonized aspen and birch in the Fairbanks area, and hemlock sawfly populations increased somewhat in the southeast; however, black-headed budworm infestations, while noticeable as far north as Circle, remained low. The Sitka spruce beetle killed patches of white and Sitka spruce on the Kenai peninsula; suppression may be warranted in that high-value recreational area.

In Oregon and Washington, the most troublesome insect was the mountain pine beetle; outbreaks occurred on some 300,000 acres of lodgepole and ponderosa pine. Another principal concern among forest landowners was the continued spread of the larch casebearer in eastern Washington and a resurgence of a needle miner in part of Oregon. Although the European pine shoot moth was found again in three Washington communities outside the containment zone, and in one forest nursery in Oregon, steps were taken to eradicate the moth in these areas.

A sharp increase in damage from bark beetles dominated the insect situation in California. In the northwestern part of the State, Douglas-fir beetles killed thousands of trees in and adjacent to areas affected by floods and strong winds 2 years ago. In the northeastern counties, the Jeffrey pine beetle was destructive. Elsewhere in the State, drought in the summer and fall triggered outbreaks of ips and gave impetus to western pine beetle infestations in ponderosa pine.

The overall condition of forest insect infestations in northern Idaho and Montana was much improved from prior years. Noteworthy was a marked decrease in the long-term outbreaks of spruce budworm in Montana. However, new but not severe budworm infestations developed near Missoula, and the population increased somewhat in northern Idaho. The larch casebearer continued its spread in stands of western larch in both States, and the larch sawfly and bud moth noticeably defoliated large areas. Other insect pests in the Northern Rocky Mountains were the pine needle-sheath miner and a pine tussock moth. The black-headed budworm resurged on the Kootenai National Forest, Mont., and on the Kaniksu National Forest, Idaho.

In the Central Rocky Mountains, forest insects were less troublesome than at any time during the past 5 years. The only noteworthy infestation of Engelmann spruce beetle occurred on the Grand Mesa-Uncompahgre National Forest, Colo. The largest and most continuous infestation of spruce

budworm was also in Colorado where light to moderate defoliation occurred on some 80,000 acres of mixed-conifer forests.

Noteworthy in the Intermountain States, in addition to the virulent epidemic of mountain pine beetle, was a sudden collapse of spruce budworm infestations on large acreages in Idaho. The only other significant infestations were defoliation of lodgepole pine by a pine tortrix in southern Idaho and western Wyoming, sawfly damage to pinyon pines in Nevada, and spotty defoliation of poplars in southern Utah.

Defoliators were the most important insect pests in the Southwest. The spruce budworm damaged one-half million acres of mixed conifers in southern and north-central New Mexico; the white fir needle miner persisted in some 50,000 acres of fir stands in northern Arizona; and a brief but virulent outbreak of Douglas-fir tussock moth occurred on ornamental blue spruce near Santa Fe, N. Mex. The southwestern pine tip moth was particularly damaging to natural regeneration and to some 2,000 acres of planted ponderosa pine in north-central Arizona. Other important insects included the Douglas-fir beetle, the Engelmann spruce beetle, and the Arizona five-spined ips; all three occurred locally in Arizona and New Mexico.

Situation in the Southern and Southeastern States

Bark beetles were the principal insect pests in the South and Southeast, and they killed many pines, particularly in Texas, Louisiana, Mississippi, and South Carolina. Fortunately, extreme cold early in 1966 halted southern pine beetle infestations in Tennessee. Other significant insect problems in the Southern States were a rise in ips infestations in portions of Arkansas and North Carolina; serious tree killing by the black turpentine beetle in Louisiana, Mississippi, and Texas; damage to young pine plantations by the pales weevil in coastal North Carolina; and continued serious infestations of the balsam woolly aphid in stands of Fraser fir in North Carolina. While defoliating insects were more widespread and more severe in some locations than in 1965, none were serious enough to warrant direct control.

Situation in the Lake and Central States and the Northeast

Forest defoliators caused the greatest damage to the forest resource in the Lake and Central States and the Northeast. The jack pine budworm was the most important pest in the Central States, where infestation increased to the point where suppression may again be necessary. The spruce budworm was the predominant insect in the Northeast, where some 100,000 acres of mixed fir and spruce near Oxbow, Me., will probably have to be suppressed. The fall cankerworm continued in outbreak numbers in northern Pennsylvania and was abundant and damaging throughout parts of West Virginia, New York, New Jersey, and Connecticut. Other forest defoliators, such as the gypsy moth, forest tent caterpillar, pine sawfly, and one or more species of loopers, decreased. Aphids, scales, weevils, leaf miners, and tip and shoot moths were damaging within their known areas of distribution in all States.

Suppression Activities

Public and private agencies cooperated to check damage and loss caused by forest insects. The major campaigns were directed against bark beetles. The largest effort by far against bark beetles was aimed at suppression of the mountain pine beetle in stands of lodgepole pine on the Targhee and Teton National Forests and in Teton National Park. At these locations, infested trees were cut and utilized, cut and burned, burned standing, or cut and sprayed with toxic oils.

The mountain pine beetle was also the target of control action in eastern Oregon. The infestations in lodgepole pine were handled primarily by logging in the affected stands. Beetles in western white and sugar pine stands were also checked by accelerating logging in the stands. Outbreaks in second-growth ponderosa pine were suppressed by a two-prong attack. Populations in affected areas were first reduced by direct means, and then the stands were thinned to reduce basal area and relieve stand pressure. In some cases thinning preceded the direct action taken to reduce populations.

Suppression in California also was directed chiefly against bark beetles, and operations were

primarily limited to logging of the infested trees. In the north coast area, where Douglas-fir beetle infestations were severe, infested trees were logged along with other components of the stand. In areas where infested trees could not be salvaged, they were cut and the beetle broods were destroyed by treating the bark surface of the trees with penetrating sprays.

In the Northern Rocky Mountains, control action was principally against spruce budworm. The largest suppression project was mostly on Bureau of Land Management lands east of Dillon, Mont. Use of 13 fluid ounces of technical malathion per acre reduced the total population 97 percent. Zectran, at a rate of 0.15 pound per gallon of kerosene per acre, was also used in a test to control the budworm on a small area of the Bitterroot Mountains, Mont. Definitive results of the test are not yet available, but control effectiveness appears to have been satisfactory.

Except for the large-scale campaigns to control mountain pine beetle infestations in Idaho and western Wyoming, only minor action was required to check damage and loss caused by other pests. The planned spraying to suppress spruce budworm on an extensive acreage of the Salmon National Forest was canceled in early June when it was learned that natural factors had reduced populations to low levels.

In the Southwest, control of forest insects was confined primarily to forest defoliators. The largest suppression project, directed against the spruce budworm in northern New Mexico, was not very successful. However, control efforts against a small outbreak of Douglas-fir tussock moth in and adjacent to Santa Fe, N. Mex., were highly successful, and no spread occurred from the focal center of infestation.

Bark beetles were the target of most of the control effort in the South and Southeast. Southern pine beetle infestations, particularly in Texas, Louisiana, Mississippi, and South Carolina, required suppression effort throughout the year. Fortunately, extreme cold in midwinter destroyed a virulent outbreak in Tennessee. Debris from floods and from stand disturbances caused by timber harvesting resulted in an upsurge in populations of black turpentine beetle, but these populations were checked by salvaging infested trees and spraying infested stumps. The pales weevil was controlled in pine plantations in North Carolina, and high-value Fraser fir were sprayed to protect them against more infestations by the balsam woolly aphid.

Suppression in the Central States, Lake States, and the Northeast was mostly in small areas. The Saratoga spittlebug was controlled, as needed, in pine plantations in Michigan; the red-headed pine sawfly was treated in several areas; and the fall cankerworm was suppressed in high-value recreational sites in Pennsylvania. Minor programs contained white pine weevil in Pennsylvania and New York, hemlock looper in New Hampshire, and jack pine budworm in Michigan and Wisconsin.

Pest suppression projects are summarized in the following tabulation:

Pest Control Accomplishments in the United States, 1966

Insect	*Location*	*Trees Treated*	*Acres Sprayed*
Southern pine beetle	South and Southeast	240, 000	----------
Black turpentine beetle	------do	[1] 249, 000	----------
Western pine beetle	California	17, 500	----------
Black Hills beetle	South Dakota, Colorado, and Wyoming	9, 000	----------
Mountain pine beetle	Utah, Idaho, and Wyoming	645, 000	----------
Spruce budworm	Montana, Idaho, and New Mexico	----------	131, 000
Balsam woolly aphid	Mississippi, Tennessee, and North Carolina	52, 000	----------
Fall cankerworm	Pennsylvania	-------- -	1, 000
Pales weevil	North Carolina	----------	4, 000
Miscellaneous	Entire United States	132, 500	23, 500
Total		1, 345, 000	159, 500

[1] Includes treating of stumps.

Forest Insect Conditions in the Various Regions

ALASKA

By DAVID CROSBY, Division of Timber Management

Juneau, Alaska

Conditions in Brief

Hemlock sawfly populations in southeastern Alaska indicated an overall increase, while the black-headed budworm remained at a low level for the second consecutive season. Defoliation was noticeable only in areas of heavy sawfly feeding. In interior Alaska the black-headed budworm was recorded on white spruce as far north as Circle. The acreage of defoliation by the western hemlock looper on the Bradfield River drainage did not increase much. A leaf tier on aspen and birch caused extensive leaf skeletonizing in the Fairbanks area.

Ambrosia beetles infested Sitka spruce and western hemlock trees felled in southeastern Alaska. Prevention and control involved prompt utilization. The spruce bark beetle killed white and Sitka spruce in patches on the Kenai Peninsula. Control plans are anticipated in areas of high resource value.

Status of Insects

Black-headed budworm, *Acleris variana* (Fern.). Although many areas have a recent history of black-headed budworm outbreaks, larval collections from 70 areas on the Tongass National Forest indicated extremely low populations. This is likely a carryover from the 1965 reduction attributed to early instar mortality from abnormally hot weather. The number of budworms collected per three-tree sample decreased from a 1965 low of 189 to a 1966 low of 36. No defoliation on the Tongass National Forest was attributed to the insect in 1966.

In Alaska's interior, the black-headed budworm was collected from white spruce along most of the principal highways: on the Kenai Peninsula along the Sterling Highway, north to Anchorage, and on to Fairbanks along the Glenn and Richardson Highways. Budworms were also collected as far north as Livengood and Circle. Larvae were discovered along the Tanana River near Northway Junction. No epidemic populations were detected in the interior, larvae were relatively abundant along the Richardson Highway from Mile 19½ west of Valdez to Mile 60, along the Copper Highway 4 miles, and 6 miles east of the Cordova airport and at the Cabin Lake Campground near Cordova.

Hemlock sawfly, *Neodiprion tsugae* Midd. Based on larval collections in 1966, high hemlock sawfly populations were noted on Chichagof Island in Freshwater Bay (Kennel Creek), Pavlof Harbor, Crab Bay, Sitkoh Bay, Baranof Island in Saook Bay, Rodman Bay, Admiralty Island in Gambier Bay, and Eliza Harbor. Also, high counts were recorded at Calder Bay, on Orr Island, Thorne Island, Stevenson Island, Tolstoi Point, and near Kasaan. Despite high larval counts in these areas, defoliation was obvious only where feeding was heavy. Additional high populations were discovered near Kake and Irish Creek on Kupreanof Island and on Kuiu Island near Rocky Pass. In these cases, medium to heavy defoliation was detected during an aerial survey.

In southeastern Alaska the number of sawflies collected by sampling increased from 2,518 in 1965 to 5,186 in 1966, suggesting a general increase. On the Kenai Peninsula, hemlock sawflies were collected north of Knik Arm and at Miles 44 and 62 on the Sterling Highway northwest of Seward. No outbreaks were found in the interior.

Large aspen tortrix, *Choristoneura conflictana* (Wlk.). The large aspen tortrix caused considerable leaf damage in interior Alaska. Heavy defoliation of aspen and birch was recorded between Miles 1399 and 1401 along the Alaska Highway. Farther north, 640 acres of defoliation occurred between Miles 292 and 294 of the Richardson Highway.

An estimated 1,500 to 2,000 acreas of defoliation occurred in the Fairbanks area on the Farmer's Loop, Miles 9 and 11 along the Elliot Highway, and along the Steese Highway between Miles 13 and 37, 44 and 47, and 54 and 55. Noncontiguous defoliated areas were observed between Bonanza Creek and Delta Junction and northward toward the Yukon River as far as the aspen type extends.

Western hemlock looper, *Lambdina fiscellaria lugubrosa* (Hulst). The western hemlock looper infestation discovered on the Bradfield River southeast of Wrangell in 1965 persisted this year. A survey revealed that the defoliated area was 400 acres in 1965. Insect feeding in 1966 caused only 30 acres of additional defoliation. The favored host in the Bradfield drainage is Sitka spruce, with western hemlock being fed upon only when the favored host becomes scarce. Spruce which were heavily defoliated in 1965 are now dying. The entire infestation is within a recently awarded timber sale.

Because the western hemlock looper was not recorded in Alaska before 1965, the 1966 aerial insect survey of southeastern Alaska gave special attention to nearby mainland drainages. Weather permitted the survey crew or Ranger District personnel to investigate most such drainages in the southern part of the Tongass National Forest. No other looper defoliation was observed on the Forest. A suspected area, observed near the Alaska-British Columbia border on the Canadian side, was reported to the Canada Department of Forestry. Correspondence with Canada did not reveal other recent western hemlock looper activity along the border.

On July 30 and August 1, insect and disease personnel assisted research entomologists in collecting 6,000 third, fourth, and fifth instar larvae for shipment to the Forest Service Insecticides Testing Laboratory at Berkeley, Calif. That office revealed the presence of a polyhedral virus in the looper population.

Alaska spruce beetle, *Dendroctonus obesus* (Mann.). This beetle has killed trees in patches on the Chugach National Forest on the west shore of Kenai Lake, at the junction of the Russian and Kenai Rivers, along the Sterling Highway in the Jerome Lake vicinity, and in the Anchor Point area. Tree mortality was heavy on 200 acres near the mouth of the Chickaloon River. The use of trap trees was discussed with District Rangers on the Chugach, and plans are being made to practice this technique on a small scale.

Ambrosia beetles. Beetles have been infesting felled Sitka spruce and western hemlock at Gustavus and on Prince of Wales Island at Cape Pole and Port Alice. Logs from harvest in the fall of 1965 (5,350 M bd. ft.) contained an average of 20–40 entrance holes per square foot and tunnels penetrating about 3 inches into the sapwood.

Recommended control was utilization or water storage of all late summer or fall felled timber before the spring flight of beetles.

Cedar bark beetle, *Phloeosinus squamosus* Blkm. The cedar bark beetle has been found in dead western red cedar on the perimeters of mus-

F–516043

Egg galleries are evidence of Alaska spruce beetle attacks.

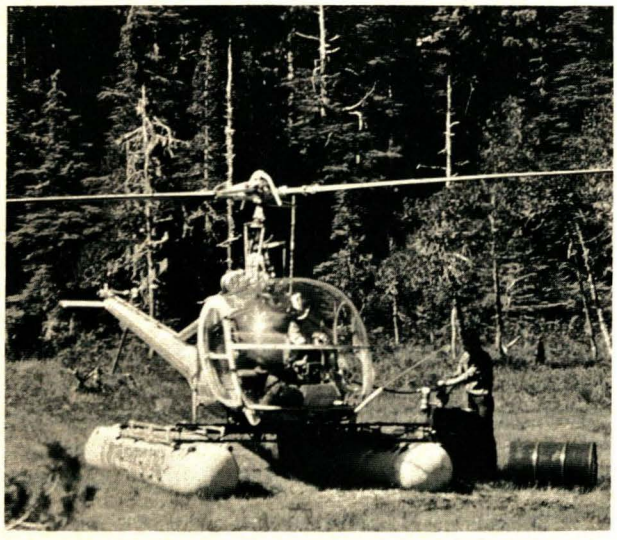
kegs and on some well-drained sites. The beetle's role in these deaths is unknown. Egg galleries are usually too few to indicate that the insect is the cause.

Dead western red cedar was readily detected from the air during August 29–31. Small patches, usually of not more than 3 acres, were recorded in southeastern Alaska from Pearse Canal and Fillmore Island to the north end of Kupreanof Island.

Cottonwood leaf beetle, *Chrysomela scripta* F. Larvae of this beetle caused leaf skeletonizing in black cottonwood at several locations in southeastern Alaska. Some trees were discolored in the Mendenhall Valley.

Cone moths. Damage to Sitka spruce cones by moths in the genus Laspeyresia was obvious at Thomas Bay, Thorne Bay, Traitors Cove, Burrough's Bay, Unuk River, and Tongass Island. The overall effect on the spruce seed crop has not been investigated.

Insects affecting regenerated stands. During May and June 1966, a 20-day survey of cutover areas was conducted in southeastern Alaska to determine the presence of problem insects. An examination of Sitka spruce and western hemlock of age 5 to 40 disclosed no problem insects. Although a special search was made for the Sitka spruce weevil, *Pissodes sitchensis* Hopk., no specimens were found.



F–516044

Helicopters supplement fixed-wing aircraft in insect evaluations and in spraying critical areas.

In October, adult weevils, *Steremnius carinatus* (Boh.), were collected in Ketchikan. They apparently emerged from firewood, but the species is reportedly capable of injuring coniferous seedlings.

OREGON AND WASHINGTON

By R. E. Dolph, Jr.,[1] Division of Timber Management

Portland, Oreg.

Conditions in Brief

Losses to forest resources in the Pacific Northwest from insects decreased slightly, involving about 1.2 million acres. Defoliation, primarily from the larch casebearer in Washington and a needle miner in Oregon, was heavy, but losses from bark beetles and sucking insects declined.

The most troublesome bark bettle pest was the mountain pine beetle. Over 300,000 acres of several pine species were infested. Logging was accelerated to check the spread of this beetle in western white, lodgepole, and sugar pine stands. Stagnated pole-size ponderosa pine stands were thinned following direct control to relieve stand pressure and prevent future attacks.

The European pine shoot moth was discovered in three Washington communities outside the containment zone. Steps are being taken to eradicate the moth in these areas. In Portland, Oreg., several infested trees were found and destroyed in one nursery.

No large-scale chemical control projects are planned for 1967.

Status of Insects

Larch casebearer, *Coleophora laricella* (Hbn.). Outbreaks in northeast Washington continued to increase in size and severity. Defoliation occurred in stands of western larch on the Kaniksu and Colville National Forests and on lands administered by the Washington State Department of Natural Resources. The casebearer is also well established on the Colville Indian Reservation west of the Columbia River. The trend of the infestation is

[1] Based on cooperative surveys with Oregon State Department of Forestry and Washington State Department of Natural Resources.

256-077 O - 67 - 2

upward. Parasites, obtained by the Forest Service, Region 1, were liberated in infested areas in 1966, and more will be released in 1967. No direct control is needed in 1967.

Larch sawfly, *Pristiphora erichsonii* (Htg.). Infestations from a few to several hundred acres developed on and near the Okanogan, Colville, and Kaniksu National Forests in northern Washington. Outbreaks on the Yakima Indian Reservation in Washington subsided to endemic levels. In Oregon, defoliation remained static on the Warm Springs Indian Reservation and subsided on the Mount Hood National Forest.

Larval feeding is expected to continue at about the same level in northern Washington and to decrease to endemic levels in Oregon. Direct control is not necessary in 1967.

Pine needle miners, *Coleotechnites* spp. near *milleri.* An explosive needle miner outbreak enveloped many thousand acres of lodgepole and ponderosa pine on the Deschutes and Winema National Forests in south-central Oregon. No trees have been killed, but repeated defoliation may make them more attractive to bark beetles. The trend of damage is apparently upward. No control is planned in 1967.

Balsam wooly aphid, *Chermes piceae* Ratz. Damage on lowland white fir in the Coast Range in southern Oregon increased, and new infestation was detected near Powers. Elsewhere, damage was static and confined to subalpine fir and Pacific silver fir along the Cascade Mountains. Most of the damage was on the Mount Hood, Willamette, and Umpqua National Forests and Crater Lake National Park in Oregon and on the Gifford Pinchot and Snoqualmie National Forests in Washington. Since direct control is impractical under forest conditions, salvaging infested, merchantable trees and those of declining value is recommended.

Hemlock sawfly, *Neodiprion* sp. Two infestations of hemlock sawfly were discovered in 1966—one on the Mount Hood National Forest in Oregon and the other on the Gifford Pinchot National Forest in Washington. Both mature and immature hemlock were attacked; most of the defoliation was late in the season. Both infestations are heavily parasitized; thus no control is planned in 1967.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. No epidemics were detected in either Oregon or Washington in 1966. The isolated outbreaks detected in the fall of 1965 in Oregon on Bureau of Land Management lands and the Fremont and Malheur National Forests collapsed completely, apparently from polyhedrosis virus and other natural controls.

Western oak looper, *Lambdina fiscellaria somniaria* (Hulst). Outbreaks of this insect continued to decline in the Willamette Valley of Oregon, apparently from diseases and parasites. No control is needed in 1967.

European pine shoot moth, *Rhyacionia buoliana* (Schiff.). In Washington, 77 communities and 44 Christmas tree farms outside the containment zone were surveyed. Damage was detected at residences in Longview, Prosser, and Port Angeles, but not until after moth flight; thus no eradication was undertaken this year. Fumigation by methyl bromide is planned for these properties in 1967 prior to moth flight. No shoot moth damage was found on the Christmas tree farms.

In Oregon, 68 communities including the Portland metropolitan area were surveyed. Several pines were found infested in a commercial nursery in northeast Portland. Immediate action was taken to destroy the infested trees and spray the remaining trees.

The results of the 1966 survey demonstrate the ease of transporting infested trees outside the containment zone. Strict quarantine enforcement, eradication surveys, and fumigation are the only actions now available for detecting and reducing the spread of this insect in the Northwest.

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. (*D. monticolae* Hopk.). Mountain pine beetle outbreaks in western white pine along the Cascade Mountains in Oregon remained static and decreased in Washington. The largest infestations in Oregon were on the Willamette, Umpqua, and Siskiyou National Forests. In Washington, most of the losses were centered on the Olympic National Park and Gifford Pinchot, Snoqualmie, Wenatchee, and Colville National Forests.

Heavy mortality occurred in overmature lodgepole pine in Crater Lake National Park and on the Fremont, Deschutes, and Winema National

Forests in Oregon. Outbreaks decreased to a very low level in Washington. Only one center of epidemic mortality—70 acres on the Yakima Indian Reservation—was detected.

Infestation of stagnated, pole-size ponderosa pine remained static in Washington and decreased suddenly in Oregon. In Oregon, the heaviest outbreaks were in Sumpter Valley on the Wallowa-Whitman National Forest. Significant losses also occurred on the Fremont, Malheur, and Winema National Forests. In Washington, most of the losses were on and near Okanogan National Forest and Colville Indian Reservation.

Outbreaks in sugar pine decreased in southern Oregon. Most of the losses were single trees on the Rogue River National Forest.

Direct control in western white pine has not been considered practical because of blister rust. Logging merchantable, infested and intermingled green pines is being recommended to reduce the beetle populations and is being used to control outbreaks in overmature lodgepole pine and in sugar pine. Direct control is being used in some of the stagnated pole-size ponderosa pine until the stands can be thinned. Thinning stagnated ponderosa pine to relieve competition and improve tree vigor is encouraged in both States.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Mortality was generally less in Washington and Oregon. Light to moderate infestations occurred on the Millacoma and Smith River drainages in the Coast Range and in the Cascade Mountains on the Umpqua and Willamette National Forests. Losses in eastern Oregon were centered on the Wallowa-Whitman National Forest. Outbreaks in western Washington occurred on the Gifford Pinchot and Snoqualmie National Forests. In eastern Washington trees were killed on or near Okanogan and Colville National Forests and Colville Indian Reservation. Losses are expected to continue downward west of the Cascades and remain static east of the Cascades in 1967. Infested trees are being salvaged to reduce the beetle population and to utilize the timber before it deteriorates. Fire-killed trees are being salvaged to prevent serious bark beetle outbreaks within or adjacent to the large 1966 burns.

Western pine beetle, *Dendroctonus brevicomis* LeC. Losses in mature ponderosa pine decreased suddenly, with most of the kills on the Malheur, Fremont, and Ochoco National Forests in Oregon. In Washington losses were centered on the Wenatchee and Okanogan National Forests and Yakima Indian Reservation. Damage is expected to be static or downward in 1967. Logging is underway or planned in most of the problem areas to reduce the beetle population and save timber.

Silver fir beetles, *Pseudohylesinus* spp. Epidemic outbreaks increased slightly on the Mount Baker and Snoqualmie National Forests and Olympic National Park in Washington. Many of the infestation areas also contained the root rot *Armillaria mellea.* No epidemic damage was detected in the Oregon Coast Range. Losses are expected to remain static next year. Logging is the only means available for reducing the beetle population and saving timber; no direct control is planned.

Engelmann spruce beetle, *Dendroctonus obesus* (Mann.). (*D. engelmanni* Hopk.). Infestations remained low in both States. Most of the outbreaks were on the Wallowa-Whitman National Forest in Oregon and on the Okanogan and Wenatchee Forests in Washington. No control is needed since losses are expected to remain static next year. Nevertheless, salvage of merchantable, infested trees is recommended.

Oregon pine ips, *Ips pini* (Say). The size and intensity of the infestations increased in Oregon and decreased in Washington. The largest infestations were on the Wallowa-Whitman, Malheur, and Ochoco National Forests in northeast Oregon and on the Rogue River Forest in the southeast. The buildup was enabled partly by drought. Losses in Washington, on the Yakima Indian Reservation and the Okanogan and Wenatchee National Forests, were very light. An upward trend is expected next year in both States. Good silvicultural practices should preclude the need for direct control.

Fir engraver, *Scolytus ventralis* LeC. Fir engraver epidemics decreased in Oregon and Washington forests. Most kills were on the Umatilla and Wallowa-Whitman National Forests in Oregon and on the Okanogan and Wenatchee National Forests in Washington. Losses from fir engraver generally increase during drought, but subside quickly when moisture conditions return to normal. No control is needed in 1967.

Other insects. The black-headed budworm, *Acleris variana* (Fern.), caused some very light defoliation of true fir and Douglas-fir on the Malheur National Forest in Oregon. Defoliation is expected to decrease in 1967.

Pandora moth, *Coloradia pandora* Blake, flight occurred on the Winema Forest near Chemult and Deschutes Forest near Sisters, Oreg. Both areas will be checked in 1967 for defoliation.

Damage from an unknown spider mite occurred on the Malheur Forest where DDT was used against the Douglas-fir tussock moth in 1965. The buildup was partly due to DDT killing the mite's natural enemies and drought conditions. Outbreaks of this pest generally subside within the year without significant damage to the stand. No control is needed in 1967.

A sawfly, *Neodiprion* sp., defoliated true firs on a limited area on the Winema National Forest near the Mountain Lakes Wilderness Area. Disease and parasites are expected to reduce the population in 1967.

A strawberry root weevil, *Brachyrhinus ovatus* (L.), caused severe damage in a Douglas-fir seed plantation on the Siuslaw National Forest. The infestation was controlled by tilling the soil and applying granular Aldrin.

A large population of unknown Eriophyid bud mites was found on ponderosa pine in southern Oregon, causing curling of needles and general deterioration. Up to 10 percent of some plantations' trees were killed.

CALIFORNIA

By John R. Pierce, Division of Timber Management

San Francisco, Calif.

Conditions in Brief

Bark beetle damage increased suddenly in California in 1966. A major epidemic of the Douglas-fir beetle killed thousands of Douglas-fir trees in the northwestern part of the State.

In northeastern California several outbreaks of the Jeffrey pine beetle caused widespread tree killing. In late summer there were ips beetle outbreaks in many young pine stands where stand improvement work, storm damage, or logging had left slash for breeding material.

Many localized outbreaks of the western pine beetle were detected in the fall. Drought encouraged an increase in beetle activities in ponderosa pine.

The European pine shoot moth was introduced despite quarantine regulations.

Suppression activities are planned for 1967 to combat bark beetle buildups. Logging of infested trees will be the principal method, but control with bark penetrating sprays will be needed in recreation areas and to supplement silvicultural control elsewhere.

Status of Insects

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. The worst recorded outbreak of the Douglas-fir beetle killed trees in virgin Douglas-fir stands over large areas of Humboldt, Siskiyou, and Trinity Counties. The infestation is centered in the Willow Creek-Hoopa Indian Reservation-Orleans area, and extends north up the Klamath River to Happy Camp, and southeast to South Fork Mountain near Hayfork. In 1965 the beetle population increased greatly in the trees downed by the storms of December 1964 and January 1965. During the spring and summer of 1966 the pest emerged from the down material and killed thousands of standing trees.

The threat of this epidemic was recognized in 1965, and salvage logging to suppress the beetle began promptly and continued through 1966. The salvage effort was hampered by a depressed lumber market and lack of access roads.

The magnitude of the problem was not apparent until large numbers of trees began to fade in late August and September 1966. Because many of the infested trees will remain green until the end of 1966, aerial and ground surveys will be conducted in the spring of 1967 to determine the full extent of the loss.

Jeffrey pine beetle, *Dendroctonus ponderosae* Hopk. (*D. jeffreyi* Hopk.). The outbreaks of the Jeffrey pine beetle reported in 1965 persisted through 1966, and several new infestations developed and increased the loss of Jeffrey pine.

The most trees were killed in Shasta, Modoc, Lassen, and Plumas Counties. At Mountain Meadows Reservoir near Westwood, 2,300 pole-size trees were treated in a cooperative control

project with State and private owners. Extensive suppression activities—mainly logging of infested trees in the spring and fall of 1966—were carried out elsewhere.

Farther south the small infestation in the Martis Valley, south of Truckee, multiplied several times during the 1965–66 beetle generation. In southern California this beetle continued to cause damage in recreation areas around Big Bear Lake and Barton Flats in San Bernardino County.

Ips (pine engraver), *Ips* spp. Drought during the summer and fall of 1966 encouraged large outbreaks of ips beetles in several young pine stands. Accumulations of slash from spring and summer timber stand improvement also may have precipitated these outbreaks. Large infestations were detected in Modoc, Lassen, Plumas, and Shasta Counties.

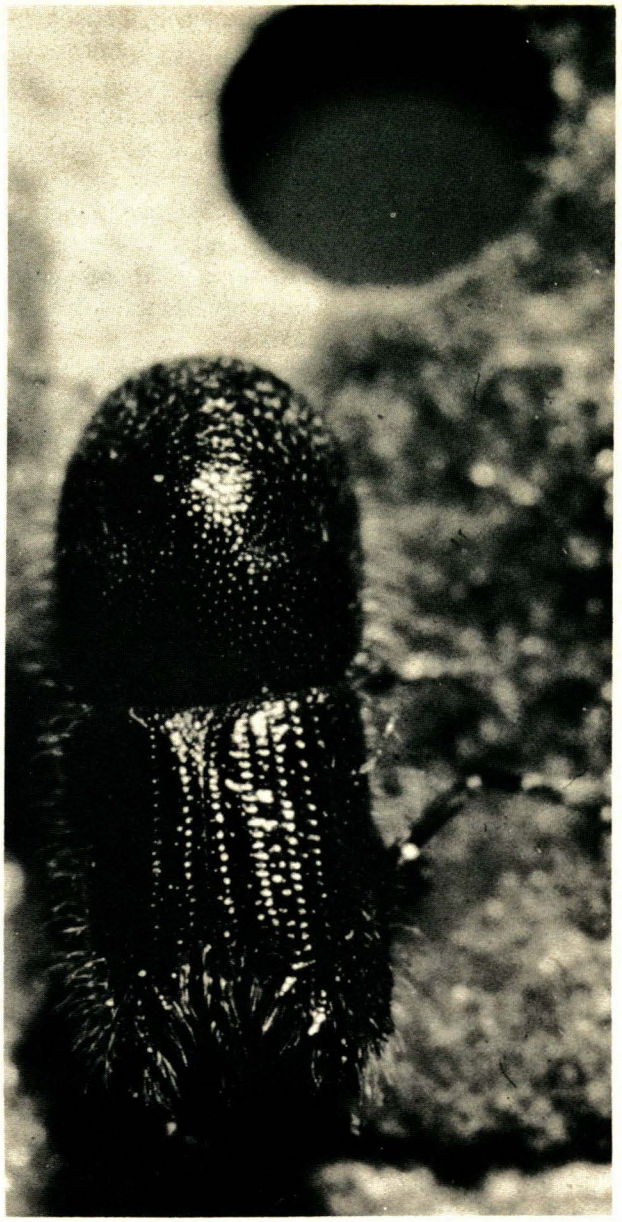
Mountain pine beetle, *Dendroctonus ponderosae Hopk.* (*D. monticolae Hopk.*). The mountain pine beetle continued to kill lodgepole pine over extensive areas in 1966. Losses were primarily in low-value stands where control was not warranted; however, some were in valuable recreation areas, where control was undertaken.

Mountain pine beetle activity in sugar and ponderosa pine continued endemic throughout central and northern California. The precommercial thinning of an overstocked ponderosa pine stand at Joseph Creek, Modoc County, appeared to be an effective control.

Western pine beetle, *Dendroctonus brevicomis* LeC. Infestations were detected in widely separated areas: Middle Creek, Bowery Flat, Lake County; Squaw Flat near Pondosa and Sacramento River Canyon, Shasta County; McCloud, Sugar Creek, Siskiyou County; Lava Peak, Lassen County; Government Flat, Grindstone Creek, Tehama County; and Figueroa Montain, Santa Barbara County.

In Siskiyou and Trinity Counties outbreaks associated with last year's flood damage subsided, and fewer trees were killed in the Bass Lake Recreation Area of Madera County. In the southern California recreation forests a high endemic level continued in several areas, like Lake Arrowhead, the San Jacinto Mountains, Palomar Mountain, and Julian.

Elsewhere in the State, losses remained tolerable except for local outbreaks. But the general warm, dry weather which prevailed during spring and summer weakened many ponderosa pines and could encourage buildup of the beetle in 1967. Some stands injured by fire during 1966 will contribute hosts, increasing the risk next year.



F–516042

Ips beetles are small but mighty. They killed many pines in California in 1966.

Other bark beetle and flatheaded borer infestations. The fir engraver, *Scolytus ventralis* LeC., remained inactive except at Barber Creek

in the South Warner Mountain, where a small infestation was detected in late fall. Infestations of the red turpentine beetle, *Dendroctonus valens* LeC., remained endemic throughout the State. Maintenance control continued in southern California recreation areas to reduce the high endemic populations of the California flatheaded borer, *Melanophila californica* Van Dyke. Larvae believed to be the flatheaded fir borer, *M. drummondi* (Kby.), were numerous in many Douglas-firs infested by the Douglas-fir beetle.

Defoliating insects. Defoliators in the conifer forests were at a low level in 1966. Activity by the white-fir sawfly, *Neodiprion abietis* complex (Harris), declined, but past feeding may lower some Christmas tree values. Sawfly defoliation of pines occurred in several local infestations.

The lodgepole needle miner, *Coleotechnites milleri* (Busck), remained endemic in Yosemite National Park and Sequoia and Kings Canyon National Parks, but continued at an epidemic level at Sentinel Meadows, Mono County. A needle miner in Monterey pine near Fort Bragg, Mendocino County, also was identified as this species. An infestation of *Coleotechnites* sp. in Jeffrey pine expanded in a small area on the San Bernardino National Forest. An estimated 55,000-acre infestation by a fir needle miner, *Epinotia* sp., detected in 1965 in red fir in Yosemite National Park and Sequoia and Kings Canyon National Parks and the Sierra National Forest, continued into 1966 with little damage.

The last active infestation of the tussock moth, *Hemerocampa pseudotsugata* McD., at Corral Creek Road in northern Modoc County, collapsed from a virus disease. Frost damage to tender foilage helped destroy young larvae by reducing the food supply.

A phantom hemlock looper, *Nepytia phantasmaria* (Strecker), which killed many Douglas-fir trees in four small outbreaks near McCloud last year, was severely infected with a virus disease. Defoliation by the 1966 generation was negligible, apparently verifying a prediction that the virus would reduce the infestation. In October, however, a flight of moths was detected at Hawkins Creek, Shasta County, indicating a remnant population; and moths were collected at a new location, Weaver Bally Mountain in Trinity County.

Infestations of a pandora moth continued at a low level on the Kern Plateau, Kern County, and at Indiana Summit, Mono County. Adult specimens were recently classified as *Coloradia lindsayi* B. & B., but the species is uncertain. In previous years, this moth was reported as *Coloradia pandora* Blake.

Defoliation of hardwoods was conspicuous in several locations in 1966. The California oakworm, *Phryganidia californica* Pack., increased for the fourth year, and the epidemic now ranges from Mexico to Mendocino County in coastal California. The fall webworm, *Hyphantria cunea* (Drury), defoliated ash and madrone near Seiad in Siskiyou County and near Camptonville in Yuba County. A casebearer, *Coleophora* sp., damaged madrone near Georgetown in El Dorado County. A satin moth infestation, *Stilpnotia salicis* (L.), declined near Alturas. Tent caterpillar populations, *Malacosoma* spp., declined in most parts of the State.

Insects of young trees. Several insect pests damaged plantations and young natural stands during the year. Malathion was applied by mist blower on 10 acres of the Institute of Forest Genetics, Placerville, to suppress the pine needle sheath miner, *Zelleria haimbachi* Busck. A small outbreak of this moth was also reported in Monterey pine near Fairfield in Solano County. A pine tip moth, probably *Rhyacionia zozana* (Kearf.), caused conspicuous damage to new growth on 2,000 trees in the Feliciana Mountain plantations on the Sierra National Forest.

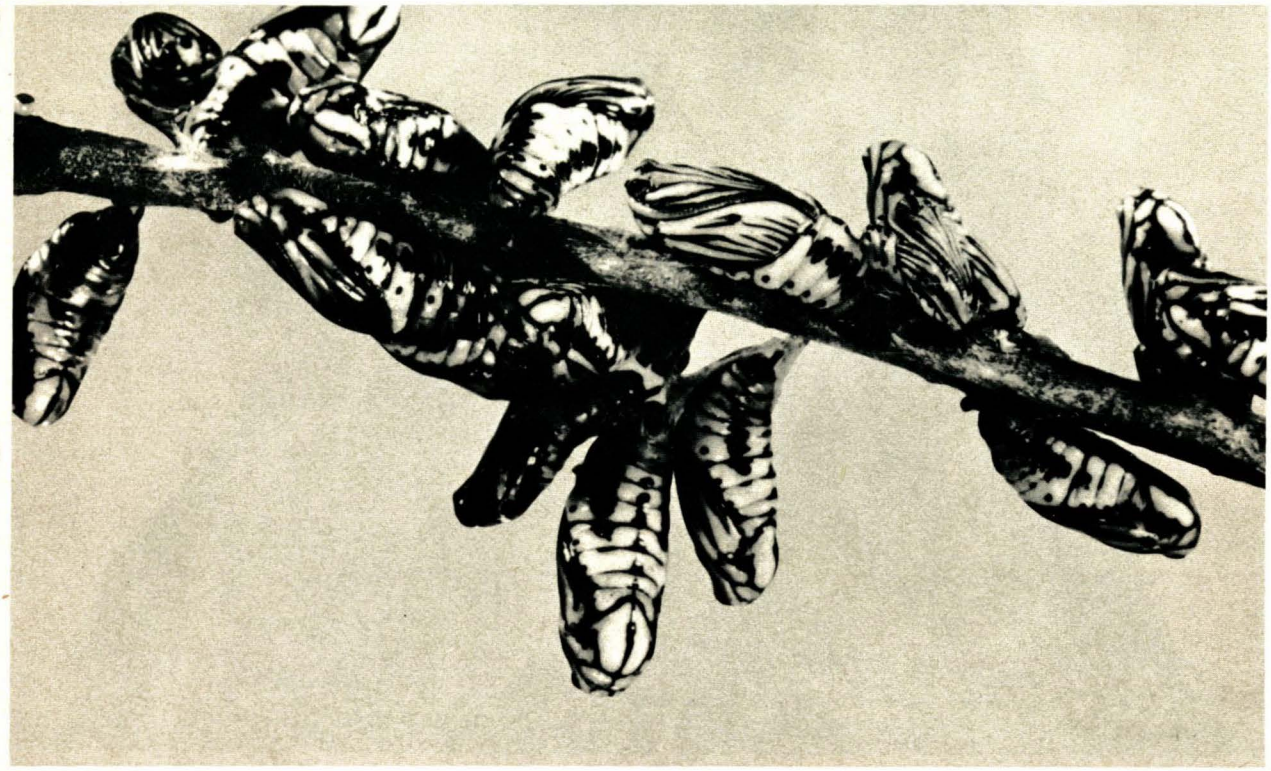
The European pine shoot moth, *Rhyacionia buoliana* (Schiff.), was found on the Davis Campus of the University of California and in a nursery in Sacramento. The State Department of Agriculture conducted a program to destroy these infestations, both of which were caused by a shipment of infested nursery stock into the State in violation of quarantine regulations.

A variety of pitch moths continued to injure trees in the Lava Butte Plantation on the Sequoia National Forest. The principal pest appears to be *Petrova edemoidana* (Dyar), accompanied by *Hilarographa regalis* (Wlsm.), *Elatobia martinella* Wlk., and *Bondia* spp. An unidentified pyralid and the Sequoia pitch moth, *Vespamima sequoiae* (Hy. Edw.), caused minor damage to small ponderosa pine in the Rhodonite seed production area, Klamath National Forest. A gouty

pitch midge, possibly *Cecidomyia piniinopis* (O.S.), caused considerable flagging of young ponderosa pine trees in several parts of northern California. In previous years this insect was reported as *Retinodiplosis inopsis* (O.S.).

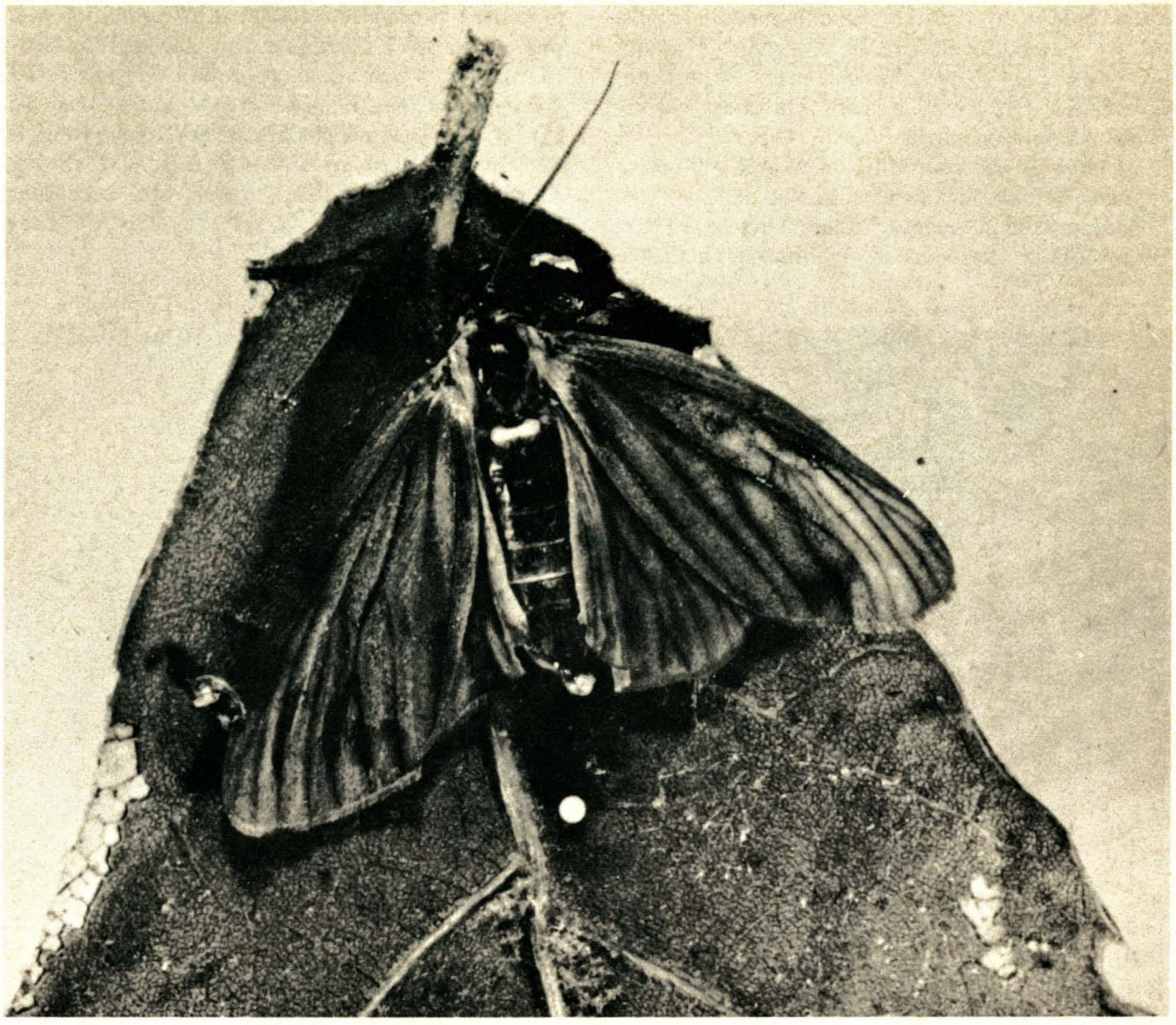
Damage by the reproduction weevil, *Cylindrocopturus eatoni* Buch., was slight in 1966.

Cone and seed insects. Insects destroyed over 70 percent of the seeds in established ponderosa pine seed production areas. The principal pest was a pine seed moth, probably *Laspeyresia miscitata* Hein. Some damage to the Douglas-fir seed crop by the fir coneworm, *Dioryctria abietella* (D. & S.), was reported in several places on the Six Rivers National Forest. A xyelid sawfly, *Xyela radiatae* Burdick, infested Monterey pine staminate flowers in Santa Cruz County near Soquel.



F–516041

These oakworm pupa are on an oak sprout.



F–516040

This female oakworm is depositing eggs. The California oakworm defoliated many oaks in coastal valleys of California from Mexico to Mendocino County in 1966.

INTERMOUNTAIN STATES

By WILLIAM H. KLEIN, Division of Timber Management
Ogden, Utah

Conditions in Brief

Destructive outbreaks of the mountain pine beetle continued to deplete the lodgepole pine forests. The most severe outbreaks were in western Wyoming and southeastern Idaho. Smaller but serious infestations are occurring elsewhere. Control efforts are reducing losses in many areas, but tree killing is increasing in the uncontrolled areas and widespread killing by the mountain pine beetle is predicted. More infestation is likely on some areas. However, peak mortality may have been reached; the Regional trend will be static to decreasing.

Spruce budworm populations were reduced greatly by a timely sequence of weather conditions. Larval populations, with the potential for heavy damage, were reduced so much by weather that

artificial control was unnecessary; a 120,000-acre control project scheduled for the Salmon National Forest was canceled.

In southern Idaho Douglas-fir beetle activity was at a low ebb except for one persistent infestation. Also in southern Idaho, favorable weather and host conditions caused a sudden ips buildup in young ponderosa pine. Losses due to other bark beetles were not significant. The sugar pine tortrix extensively defoliated lodgepole pine in southern Idaho and western Wyoming. A sawfly continued to defoliate pinyon pine on a wide area in southern Nevada. In southern Utah Fremont poplar was heavily damaged by a tent caterpillar. Entomologists predict that this caterpillar will be reduced to a tolerable level by natural factors in 1967. In central Utah, natural factors were also responsible for a sudden decline of a looper on white fir. The looper had caused considerable damage. Less important insect pests continued to attack conifers, hardwoods, and range and forage plants throughout the Intermountain West.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. (*D. monticolae* Hopk.) continued its relentless and widespread killing of lodgepole pine in the Intermountain States. Severe infestations persist in the Teton National Forest and in Grand Teton National Park in western Wyoming, and on the Targhee National Forest and adjoining Bureau of Land Management, State, and private lands in western Wyoming and southeastern Idaho. Less severe but serious infestations continue to deplete lodgepole pine stands on the Sawtooth National Forest in south central Idaho, on the Bridger National Forest in western Wyoming, and on the Caribou and Cache National Forests in southeastern Idaho. The large outbreaks that killed very many lodgepole pine in past years on the Ashley and Wasatch National Forests in northern Utah have been controlled.

Large-scale control efforts are being carried on in eastern Idaho and western Wyoming to stop the spread of the twin epidemics on the Targhee and Teton National Forests. Important timber and recreational values must be protected. Logging is used for control where possible, but the major control effort has been by chemical spraying for standing or felled trees and by felling and burning. Except for one area on the Targhee National Forest, the extremely high rate of increase of the past few years has been checked in all of the treated areas. The area where the infestation was not reduced was susceptible to invasion from beetles reared on adjoining nontreated lands. Here nearly as many trees were attacked in 1966 as were treated in 1965. It is planned to treat all lands in 1967, regardless of ownership, if agreements are obtained.

The huge infestations north of Jackson Hole, Wyo., and on the Rexburg District of the Targhee National Forest, where no control work has been done, continue unabated. The Jackson Hole infestation is pushing deeper into the upper reaches of the Teton Wilderness Area, and is now within a few miles of Yellowstone National Park. The Rexburg infestation, which is somewhat removed from the main Targhee infestation, is beyond the practical control point; more than 600,000 trees were attacked this year.

Minor increases in tree killing and extension of infestation boundaries continue in the Hoback River drainage of the Teton National Forest, and to a lesser extent in portions of the Bridger, Caribou, and Cache National Forests.

Biological data indicate that the peak of tree killing by the mountain pine beetle on most areas in the Region has been reached. Increased tree killing is predicted for a few areas, such as for the Hoback River infestation and the Diamond Flat infestation on the Caribou National Forest, but static conditions should generally prevail elsewhere. A decline of activity may be most noticeable in most of the infested areas on the Targhee National Forest. There, effective control efforts, depletion of host material, less aggressive broods, and other factors indicate a decreasing trend.

A small but aggressive infestation continues to kill young ponderosa pines on State and private lands near Cascade, Idaho. The mountain pine beetle has persisted in this area for the last 3 years; it has killed 2,000 to 3,000 trees each year. Mortality is not expected to decrease in 1967.

Spruce budworm, *Choristoneura fumiferana* (Clem.), was significantly reduced in most of the Intermountain Region. Unexpected but significant population declines occurred on the Salmon, Challis, Payette, Boise, and Targhee National

256-077 O - 67 - 3

Forests in southern Idaho and on the Fishlake National Forest in southern Utah. The only increases in budworm activity occurred in portions of the Sawtooth and Targhee National Forests in southern Idaho and on the Bridger National Forest in western Wyoming.

The area of noticeable defoliation from budworm feeding dropped from 1½ to less than 1 million acres. Most of the defoliation was light; thus, areas damaged for 2 or more successive years by heavy feeding received much-needed relief.

A sequence of weather conditions reduced these potentially moderate to heavy populations. Early fall and late spring subfreezing temperatures killed budworm larvae directly by freezing and indirectly by destroying the insects' primary food supply—new-growth Douglas-fir foliage. The widespread population decline resulted in the cancellation of the proposed 120,000-acre control project on the Salmon National Forest. The pilot test of Zectran was carried out as scheduled with lower larval populations than desired, but spray and drift experiments and aquatic and terrestrial surveillance were generally adequate.

Extensive egg mass surveys indicate that the intensity and extent of budworm feeding activity will increase slightly throughout the Region in 1967. This respite may be only temporary. Unless subsequent biological indications show otherwise, it is very likely that in a short time, perhaps in 3 to 4 years, budworm populations will reach damaging levels.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk., activity has declined slowly but steadily since 1962. An exception is the chronic infestation in the Sublette division of the Sawtooth National Forest; there tree killing is continuing. Logging in that area has retarded but not completely stopped the infestation. More than 500 Douglas-fir trees were attacked in a single large group on the Bridger National Forest, but elsewhere the numbers of infestation centers and trees killed decreased considerably. A continuation of the relatively low level of activity is predicted for 1967.

Ips beetles (pine engravers), *Ips* spp. A sequence of coincidental factors favorable to ips buildup caused widely scattered outbreaks of this beetle on the Salmon, Payette, and Boise National Forests in southern Idaho. Slash from late summer and fall logging, which was left during the winter, did not dry out as expected; consequently, heavy broods of ips beetles were produced. Fresh slash and some standing ponderosa pine trees were attacked. The hot, dry summer was conducive to rapid brood development and to low tree resistance. In normal years, timely logging and thinning will preclude an ips buildup.

Western pine beetle, *Dendroctonus brevicomis* LeC. Killing of ponderosa pines by the western pine beetle remained at a relatively low level. Two small infestations developed in southern Utah on the Dixie National Forest; control work is planned there in 1967. Both infestations are scattered throughout overmature ponderosa pine stands. No increase in activity is forecast for 1967.

Englemann spruce beetle, *Dendroctonus obesus* (Mann.) (*D. engelmanni* Hopk.), populations are again at a low level in the Intermountain States. Small, isolated buildups have occurred in windthrow on the Cache National Forest and in logging slash on the Ashley, Uinta, and Dixie National Forests, Utah, but all the infested material has been removed, or will be removed, before the beetles mature and become a threat to standing timber. There is little likelihood of a beetle buildup in 1967.

Sugar pine tortrix, *Choristoneura lambertianae* (Busck), is the remaining active member of a complex of lodgepole pine terminal feeders which included *Argyrotaenia* spp.; the jack pine budworm, *Choristoneura pinus* Free.; and the pine needle sheath miner, *Zelleria haimbachi* Busck. Several years ago the combined activity of this group of insects caused widespread defoliation of lodgepole pine. During the last 2 years the sugar pine tortrix gradually has become the dominant defoliator, as the numbers of the other species of the complex have dwindled. Extensive areas of lodgepole pine on the Targhee, Teton, and Bridger National Forests in western Wyoming and on the Caribou National Forest in eastern Idaho were defoliated by the sugar pine tortrix. Feeding damage was confined to the new growth, and in some areas almost complete removal of new foliage occurred. Although some stands have been subjected to several years of heavy defoliation, tree mortality has yet to occur. The status of this insect is unknown. No control is planned.

A sawfly, *Neodiprion edulicolus* Ross, was epidemic for the second straight year on more than 250,000 acres of pinyon pine in southern Nevada. This year defoliation decreased slightly, but the outbreak boundaries remained essentially unchanged. Following egg hatch this spring, larval populations were abundant; however, many larvae were killed by a June frost. The survivors, although sufficiently numerous to create moderate damage, were heavily parasitized, as were the pupae. Systematic pupae counts indicate that there will be a general but significant decrease in size of infestation and intensity of defoliation in 1967.

A tent caterpillar, *Malacosoma* spp. severely defoliated stands of Fremont poplar along the Virgin River, from Beaver Dam, Ariz., into Zion National Park in southern Utah. Mistblower application of *Bacillus thuringiensis* was undertaken in Zion National Park to control potentially heavy populations in scenic and camping areas. This control effort, aided by a series of natural factors, should result in a significant population decline in 1967, and trees that have been subjected to repeated heavy defoliation should have a chance to recover.

A white-fir looper, *Nepytia freemani* Monroe, severely defoliated white fir and caused some damage to Englemann spruce and Douglas-fir trees in Timpanogos Cave National Monument and on the Uinta National Forest in northern Utah. Defoliation from this geometrid was so severe on some trees that partially starved larvae were forced to feed on understory herbaceous plants. White fir, the preferred host, suffered considerable damage, with top killing occurring in some trees. The infestation, covering some 200 acres, is in its second consecutive year, but biological factors, including starvation, heavy parasitism and predation, and a light overwintering egg population, indicate light to negligible activity in 1967. No control will be needed.

White-fir needle miner, *Epinotia meritana* Hein. Relatively heavy populations of the white-fir needle miner were detected in one locality in southern Utah. Moderate to heavy damage of white fir occurred in Crawford, Cougar, and Blubber Creeks on the Dixie National Forest and in portions of Bryce Canyon National Park. Heavy activity in these areas in 1967 is indicated.

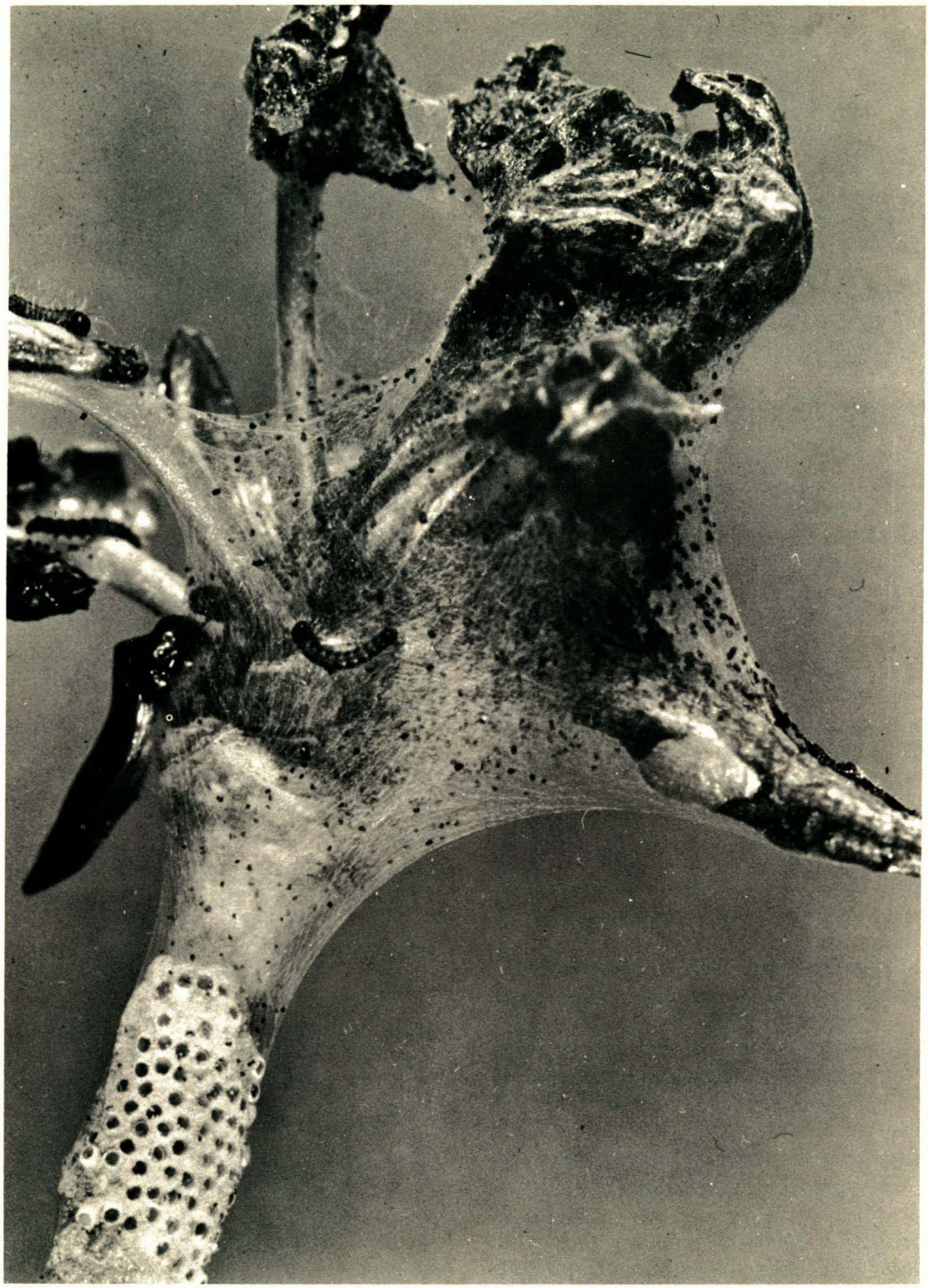
Aspen leaf tier, *Sciaphila duplex* (Wlsm.). The anticipated heavy defoliation of aspen by the aspen leaf tier and an associated defoliator, the large aspen tortrix, *Choristoneura conflictana* (Wlk.), on portions of the Fishlake and Dixie National Forests, Utah, did not materialize. The same early frosts that killed spruce budworm larvae severely reduced leaf tier-aspen tortrix populations. Much of the new aspen foliage was also killed, but the trees refoliated in the summer. Both of these defoliators are expected to remain at low levels in 1967.

A geometrid, *Anacamptodes clivinaria* (Guenee). Populations of this geometrid, which have been defoliating mountain mahogany on Bureau of Land Management lands in Owyhee County, Idaho, reached a peak in 1964, and have since steadily decreased. Very light feeding occurred in 1966, and even less activity is expected in 1967.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD., which caused defoliation of more than 3,000 acres of Douglas-fir in Owyhee County, Idaho, in 1965, was active on less than 600 acres in 1966. The decline is most likely due to the presence of a natural polyhedrosis virus in the population.

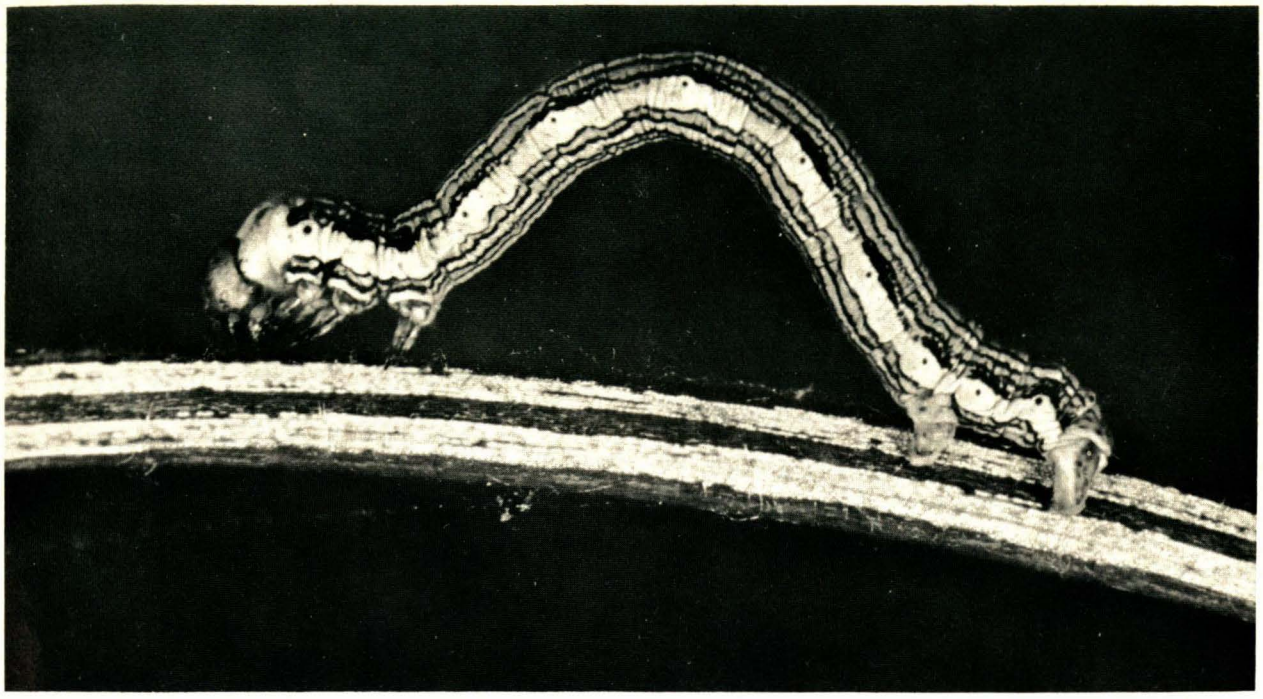
Another **tussock moth,** *Hemerocampa* sp., continued to feed on ceanothus, bitterbrush, and other broad-leaved plants in the Town Creek Plantation of the Boise National Forest. Some migrating larvae fed on intermixed planted ponderosa pine trees; however, only negligible defoliation of the old-growth needles occurred. Egg mass surveys indicate a static trend for 1967.

Other insects. A weevil, *Pissodes* sp., killed terminal leaders of lodgepole pine reproduction on the Sawtooth and Ashley National Forests. Crested wheatgrass on more than 200,000 acres of range land on National Forest and Bureau of Land Management land in southern Utah was heavily damaged by the grass plant bug, *Labops hesperius* Uhler. Tent caterpillars, *Malacosoma* spp., moderately damaged a variety of range plants in localized outbreaks in southern Utah and eastern Nevada. The red turpentine beetle, *Dendroctonus valens* LeC., was extremely active in one ponderosa pine stand on the Salmon National Forest in Idaho. More than 300 acres of a browse plant, snowberry, were defoliated by the sheep day moth, *Pseudohazis* sp., on the Caribou Na-



F–516036

Young larvae of a tent caterpillar are building a tent over a new shoot of Fremont poplar just above the egg from which they hatched.



F–516037

Mature larva of a fir looper, *Nepytia freemani* Monroe, are on a needle of white fir, *Abies concolor*, its preferred host.

tional Forest in Idaho. Localized areas of Englemann spruce on the Fishlake and Dixie National Forests in southern Utah continue to support heavy populations of a mealy bug, *Puto* sp.

NORTHERN ROCKY MOUNTAINS

By SCOTT TUNNOCK, Division of State and Private Forestry
Missoula, Mont.

Conditions in Brief

Mountain pine beetle infestation increased slightly in most stands of mature western white pine in Idaho and Montana. The beetles remained active in lodgepole pine stands and were often found in the bases of ponderosa pine trees top-killed by ips in western Montana, and killed many ponderosa pines in two areas on the Lewis and Clark National Forest, Mont. The pine engraver killed thousands of ponderosa pines in groups of 5 to 400 trees along major drainages in northern Idaho and western Montana. Spruce budworm defoliation decreased in most of Montana, but the outbreak spread west and north of Missoula. The infestation spread in northern Idaho. The larch casebearer continued to spread through the western larch type in Idaho and Montana. Larch sawflies damaged 230,600 acres of larch in the two States, and the larch bud moths moderately defoliated 518,000 acres in Montana.

The black-headed budworm, inactive since 1957, heavily defoliated stands of hemlock on the Kootenai National Forest, Mont., and on the Kaniksu National Forest, Idaho. Pine tussock moths moderately damaged ponderosa pines on 17,000 acres near Ashland, Mont. Pine needle sheath miners were on a few pines near Missoula, and pitch mass borers infested about 400 lodgepole pines at Trout Creek, Mont.

Status of Insects

Mountain pine beetle, *Dendroctonus ponderosae* Hopk. (*D. monticolae* Hopk.). Chronic infestations continued to deplete the volume of mature western white pine on the Kaniksu, Coeur d'Alene, St. Joe, and Clearwater National Forests in Idaho and on the Kootenai and Flathead National Forests, Mont.

Mountain pine beetle damage doubled on a 600-acre lodgepole pine stand southeast of St. Regis,

Mont.; an estimated 2,000 trees were killed. Within 1 to 2 miles of this large outbreak, three other stands contained 100 to 200 infested trees. Remnants of an outbreak that reached its peak in 1964 are in a few lodgepole pine stands near the headwaters of the Yaak River, Mont.

Vigorous mountain pine beetle broods are infesting the bases of many ponderosa pine trees top-killed by *Ips pini*. These infestations extend along major drainages from Darby to Trout Creek, Mont. Damage was about the same as in 1965 on the Lewis and Clark National Forest, Mont. Scattered groups of 4 to 100 infested trees were detected within the Judith River drainage and the foothills of the Big Snowy Mountains.

The level of mortality is expected to continue during 1967 in all infested areas.

Pine engraver, *Ips pini* (Say). (*I. oregonis* (Eichh.)). Damage by this beetle in the Northern Region had not been so prevalent since 1961. Its development is favored by hot, dry springs and summers. In Montana, more than 300 groups of ponderosa pine, containing 5 to 400 trees, were attacked in stands extending north along the Bitterroot Valley and Clark Fork Valley from Darby to Trout Creek. About 4,000 trees on 500 acres near Tarkio were killed.

In northern Idaho, damage was not as severe; however, several groups of up to 300 infested trees were detected east of Grangeville. Occasional smaller areas of infestation occurred in ponderosa pine types along the forks of the Clearwater, Salmon, and Coeur d'Alene River drainages.

Populations will probably decline in 1967.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Populations dropped to their lowest level since 1961. Some areas that contain active infestations are at the head of Swan Creek, east of Kooskia, Idaho; Moose Creek Ranger District, Idaho; and the headwaters of Slate Creek, Idaho.

Western pine beetle, *Dendroctonus brevicomis* LeC. This beetle has not been a destructive pest for many years in the Northern Region. It was in the bases of ponderosa pine trees top-killed by *Ips pini* during 1961 and again in 1966. Under these circumstances, broods are not abundant enough to attack healthy trees the following year.

Engelmann spruce weevil, *Pissodes engelmanni* Hopk. Terminals destroyed by weevils are noticeable in almost all stands of spruce reproduction. Damage from this weevil occurs consistently on land near Upper Pinkham Creek, south of Eureka, Mont.

Bark weevil, probably *Pissodes curriei* Hopk. On the Clearwater National Forest, Idaho, a few western white pine saplings were infested near their root collars. This weevil, usually a secondary pest, killed several pines in Glacier National Park about 4 years ago.

Spruce budworm, *Choristoneura fumiferana* (Clem.). Egg mass counts from permanent plots indicate a decline in infestations in Montana south and east of Missoula. The number of egg masses is the lowest recorded since the plots were established in 1959 (table 1). Foliar damage in south-central Montana appeared to cover only about 25 percent as much acreage as it did in 1965. However, new infestations near Missoula indicate the outbreak is moving both west and north.

Two heavily defoliated areas of Douglas-fir were sprayed with 13 ounces of undiluted technical malathion per acre. East of Dillon 62,000 acres were treated, and 97-percent control was obtained. South of Livingston, in the Mill Creek drainage, 87-percent control was achieved on 20,000 acres.

In Idaho, the acreage of budworm infestation increased. A new infestation was observed on the Powell District, Clearwater National Forest, for the first time since 1959. Egg masses were also more numerous (table 1). Foliar damage declined somewhat in the eastern part of the Nezperce National Forest, but it increased in the western part.

Larch casebearer, *Coleophora laricella* (Hbn.). This insect has infested more than three-quarters of the western larch type in Idaho and Montana since it became established near St. Maries, Idaho, about 1953. The boundaries of the infestation now extend from the Canadian border, south to Elk City, Idaho, and east to the Swan River, Mont.

Malathion several times proved adequate against this pest. Also, the parasitic wasp, *Agathis pumila* (Ratz.), was imported from New England and propagated. About 5,000 parasites were "planted" at each of 36 sites in Idaho and Montana. Distribution of these wasps will be continued in 1967.

TABLE 1.—*Measurements related to spruce budworm infestations*

Factor	Montana								Idaho	
	1959	1960	1961	1962	1963	1964	1965	1966	1965	1966
Percent defoliation	38.00	34.00	37.00	25.00	35.00	35.00	38.00	25.00	[1] 60.00	[2] 40.00
Egg masses per M sq. in. of foliage	10.40	4.10	8.40	10.50	9.50	11.90	5.33	3.12	2.43	5.07
Percent egg parasitism	3.80	1.00	4.30	6.00	.00	1.10	.50	.00	.00	.00

[1] Data from three plots.
[2] Data from eight plots.

Larch sawfly, *Pristiphora erichsonii* (Htg.). Infestations have been prevalent for the past several years in northern Idaho and Montana. The amount of damage increased in 1966. Noticeable defoliation occurred in 23 areas, which totaled about 27,000 acres, along the eastern boundaries of the Kaniksu National Forest, Idaho. More than 30,000 acres were infested in the headwaters of the Little North Fork Clearwater River and St. Joe River, Idaho. Also, 3,600 acres were heavily damaged along the Slate Creek drainage, Nezperce National Forest, Idaho. The Kootenai National Forest, Mont., had 98,000 acres of defoliation, and 72,000 acres were recorded on the Tally Lake District, Flathead National Forest, Mont. Total damage covered 230,600 acres.

Larch bud moth, *Zeiraphera griseana* (Hbn.). Damage by this insect has been increasing in Montana since 1963. A total of about 518,000 acres of western larch were moderately defoliated in 1966; about four-fifths of this acreage was on the Lolo National Forest and Flathead Indian Agency lands.

About 66,000 acres were affected on the Kootenai National Forest, and 52,000 acres were heavily damaged along west- and east-facing slopes of the entire Swan River drainage, Flathead National Forest.

Black-headed budworm, *Acleris variana* (Fern.). This defoliator has not been active in northern Idaho or Montana since 1957. However, in 1966 it damaged 10 different stands of hemlock (about 18,000 acres) along the western boundaries of the Kootenai National Forest, Mont., from Ross Creek north to Spread Creek in the Yaak River drainage. Also, budworms fed heavily on hemlock and subalpine fir trees within 17,000 acres scattered throughout 12 stands on the Kaniksu National Forest, Idaho. The largest infested area, 4,800 acres, was in the Lightning Creek drainage. The infested stands have a low commercial value; therefore, control was not considered.

Pine tussock moth, *Dasychira* sp. near or equal *grisefacta* Dyar. Large populations were recorded for the first time in eastern Montana during 1965. However, there was a significant decrease in 1966, and only about 17,000 acres of ponderosa pine contained visible defoliation. This infestation is 10 air miles northeast of Ashland. A high rate of polyhedrosis virus was in samples of larval collected during April and in those reared from thousands of eggs collected in late August. The virus will greatly contribute to the decline of this outbreak in 1967.

Pine needle sheath miner, *Zelleria haimbachi* Busck. Only two reports of minor damage by this moth were received. A few ponderosa pine and lodgepole pine trees near Missoula, Mont., were infested.

Lodgepole pitch borer, *Vespamima* spp. A notable infestation of this clearwing moth was discovered at Trout Creek, Mont., in a sapling-size lodgepole pine stand. More than 400 trees were attacked after this stand had been pruned and thinned during the late spring of 1964. Numerous trees had up to five larvae feeding within pruning cuts, and many trees were nearly girdled around their root collars by larval mines.

CENTRAL ROCKY MOUNTAINS

By JOHN F. CHANSLER and WILMER F. BAILEY, Division of Timber Management

Denver, Colo.

Conditions in Brief

Forest insect damage in the central Rocky Mountains was the lowest in 5 years. The few significant problems centered around infestations of the Black Hills beetle, the Engelmann spruce beetle, and the spruce budworm. The Great Basin tent caterpillar, Douglas-fir tussock moth, and the tiger moth are in the Region, but have caused little economic damage to forest trees.

While losses to the Black Hills beetle were low on National Forest lands in the Black Hills, there were additional serious losses on some State and private land in the northern Black Hills. An abatement program was not attempted. Some reinfestation is occurring on some National Forest lands that border these private lands. Outbreaks on the San Juan and Shoshone National Forests, while of little economic importance in 1966, progressed to the point where serious outbreaks now seem likely.

Engelmann spruce beetle problems usually did not materialize despite much scattered spruce blowdown in 1965. A noteworthy exception exists on the Grand Mesa-Uncompahgre National Forest. Small infestations are associated with logging on the Medicine Bow, San Isabel, White River, and Rio Grande National Forests.

Moderate to heavy spruce budworm defoliation occurred on 80,000 acres of mixed-conifer forests in Colorado. Defoliation has been heavy in many areas during the past 3 years, but tree mortality or extensive killing of tops has not occurred.

Status of Insects

Black Hills beetle, *Dendroctonus ponderosae* Hopk. Ponderosa pine mortality on the Black Hills Forest was the lowest in several years. However, many trees continued to be killed on some State and private land in the northern Black Hills where no control work was done. Because of this situation, some reinfestation is occurring along the borders of previously treated forests. Control to correct this situation in two key areas is anticipated in 1967.

Ponderosa pine losses on the San Juan Forest in southwestern Colorado became more important as the infestation spread from inaccessible canyons to the surrounding mesas. While the infestation caused little damage in 1965, it is now threatening ponderosa pine on several thousand acres. Tree killing on the Front Range was generally low except for moderate losses in the Redfeather Lakes area of the Roosevelt National Forest. Elsewhere in Colorado, Black Hills beetle populations are low.

In Wyoming, Black Hills beetles killed small numbers of ponderosa pine on State and private lands, particularly in the northeast. The infestation on the Bighorn National Forest declined in 1966 and is no longer a problem.

An infestation in lodgepole and limber pine on the Lander District, Shoshone National Forest, bears watching. Tree losses were not heavy in 1966 but were greater than in 1965. Moderate mortality continued in scattered patches of noncommercial limber pine on the Wapiti and Clarks Fork Districts.

Engelmann spruce beetle, *Dendroctonus obesus* (Mann.). Engelmann spruce beetle damage was of no economic importance. Populations did not increase as expected as a result of the 1965 spruce blowdown, except on the Grand Mesa-Uncompahgre Forest east of Ridgeway, Colo. Here, control work is planned before the beetles emerge. A chemical control project will be necessary to reduce the beetle population in a small patch of down spruce on the Rio Grande Forest. Small infestations associated with logging and road construction on the Salida District, San Isabel Forest; Holy Cross District, White River Forest; and the Bow River District, Medicine Bow Forest are expected to be controlled in 1967.

Spruce budworm, *Choristoneura fumiferana* (Clem.). Infestations occur on 80,000 acres of mixed-conifer forest in Colorado. The largest and most continuous infestation (about 75 percent of total acreage) is east of the Sangre de Cristo Range on the San Isabel Forest. Here, defoliation has been heavy during the past 3 years, but permanent damage has not yet occurred. The remaining infested acreage consists of small, isolated, moderate outbreaks on the Rio Grande, San Juan, Gunnison, Grand Mesa-Uncompahgre, and

F–516031

The Black Hills beetle killed many ponderosa pines on private lands in the northern Black Hills.

Roosevelt National Forests. No suppression work is planned in 1967.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD., in 1965 seriously defoliated ornamental blue spruce in the small community of Monument, Colo. This infestation caused considerable alarm because of the tremendous popularity of blue spruce. Owners have been spraying the infested trees and have apparently stopped the infestation from spreading.

Tiger moth, *Halisidota ingens* Edws. In 1965 this pest of ponderosa and pinyon pines became abundant northwest of Colorado Springs, in the Black Forest. It was important mainly because it

was a nuisance to the residents in the area. Small-scale spraying programs by State and private individuals relieved the problem in some areas. However, the problem was not solved because many active larval colonies were located in the fall.

Great Basin tent caterpillar, *Malacosoma fragile* (Stretch). Caterpillar populations were unexpectedly low in the aspen stands in the Rio Grande Forest along the Colorado-New Mexico State line; they had caused severe defoliation in this area in 1965. A similar infestation collapse was recorded in the same area in 1960.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. Populations remained endemic through

F–516029

Tiger moth, *Halisidota ingens* Edws., shown feeding on ponderosa pine, has been a problem for residents in the Black Forest, and area northeast of Colorado Springs, Colo.

1966 except for small infestations on the Gunnison and San Juan National Forests. These infestations have continued unchecked for several years because control is not justified.

Pine engraver, *Ips pini* (Say). Populations remained endemic throughout the Central Rocky Mountains. The pest was most commonly found on the San Juan and Grand Mesa-Uncompahgre Forests attacking the tops of overmature, weakened trees.

SOUTHWESTERN STATES [1]

By D. D. LUCHT, Division of Timber Management [2]

Albuquerque, N. Mex.

Conditions in Brief

The spruce budworm was the most important insect pest of Southwestern forests in 1966. It damaged one-half million acres of mixed conifer in southern and north central New Mexico. Low-volume malathion at 13 ounces per acre failed to suppress a rapidly increasing budworm population on 60,000 acres. The Douglas-fir tussock moth, inactive in the Region since 1961, became active in three old centers and in one new center. The new center in the city of Santa Fe was promptly controlled to prevent spread to the nearby Santa Fe National Forest. The white-fir needle miner remained active on 50,000 acres of white fir in northern Arizona. The southwestern pine tip moth injured 66,000 acres of natural regeneration and 2,000 acres of pine plantations in north central Arizona. An unidentified tussock moth, which severely stripped broadleaf trees in high-use recreation areas in southern New Mexico in 1965, was successfully controlled in 1966.

Three species of bark beetles—the Douglas-fir beetle, the Engelmann spruce beetle, and the Arizona five-spined ips—killed many trees in Arizona and central New Mexico. The Douglas-fir beetle was widely fatal throughout northern Arizona, while the Engelmann spruce beetle remained epidemic on Mt. Taylor in central New Mexico. In central Arizona, the Arizona five-spined ips killed several thousand pole-size ponderosa pines. This was a sudden increase in ips activity and tree mortality over 1965. Roundheaded pine beetle population is at its lowest level in several years. Several species of seed and cone insects caused heavy damage to coniferous seed and cone crops throughout New Mexico.

Cultural control was directed against the Engelmann spruce beetle, the Douglas-fir beetle, and the Arizona five-spined ips. A pilot test, using Thuricide 90 TS, had excellent results against the Nevada buck moth. Chemical control was very successful against the Douglas-fir tussock moth but proved unsuccessful against the spruce budworm. Pilot testing of a new method of bark beetle control, injection of cacodylic acid into infested trees, was highly successful in reducing broods of the Douglas-fir beetle, the roundheaded pine beetle, and the Black Hills beetle.

Status of Insects

Spruce budworm, *Choristoneura fumiferana* (Clem.). The spruce budworm continued as a major pest on 440,000 acres of mixed conifer throughout New Mexico. Of the four areas now active, only one, on the Carson National Forest east of Taos, increased. This, a 2-year-old infestation, intensified in and north of the 1966 treated area and spread from 50,000 to 80,000 acres. Control efforts, using low-volume malathion, were generally regarded as unsuccessful. The infestations in the other three areas either declined or remained static. The area of infestation on non-Federal lands near Chama and Cimarron decreased from 310,000 to 270,000 acres. In southern New Mexico, the infestation on the Gila National Forest collapsed, while that on the Lincoln National Forest remained static at 90,000 acres.

Douglas-fir tussock moth, *Hemerocampa pseudotsugata* McD. The Douglas-fir tussock moth is again active throughout central New Mexico and southern Arizona, after 5 years of quiescence. A new outbreak occurred on ornamental blue spruce, Douglas-fir, and white fir within the city of Santa Fe, N. Mex. Prompt control action was taken by city, State, and Federal agencies to prevent spread to the Santa Fe National Forest. Also, this moth

[1] Includes all forested lands in Arizona and New Mexico and National Park Service land in southern Colorado and western Texas.

[2] Seed and cone insect information provided by Dr. H. Grant Kinzer, New Mexico State University, University Park.

was found active in three old infestation centers: on the Sandia Mountains, east of Albuquerque; on Pinal Mountain, south of Globe, Ariz.; and on Aztec Peak in the Sierra Ancha Mountains, north of Globe. Checks of two other old centers in New Mexico—in the Capitan Mountains near Capitan, and in the San Mateo Mountains south of Magdalena—did not reveal tussock moth activity.

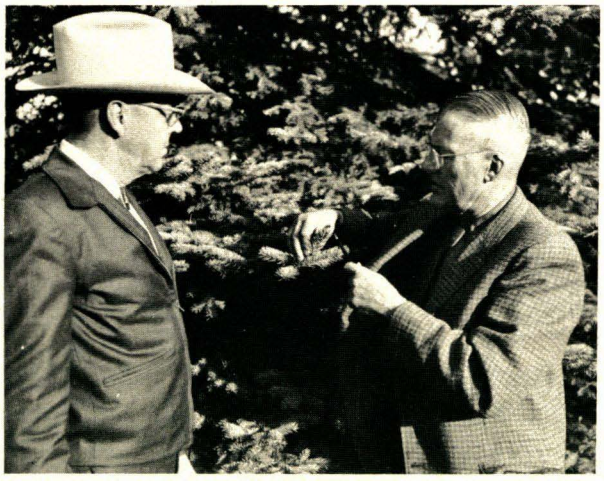
White-fir needle miner, *Epinotia meritana* Hein. Although the 2-year-old infestation declined, it remains a threat on about 50,000 acres of white fir along the common boundary of Grand Canyon National Park and the Kaibab National Forest in northern Arizona. Near Cape Royal, within the Park, damage by the miner decreased. Although the intensity of the infestation declined, deterioration of the white fir stand is expected to continue through 1967.

Engelmann spruce beetle, *Dendroctonus obesus* (Mann.). In New Mexico the spruce beetle continued to kill mature spruce on Mt. Taylor near Grants. Woodpeckers are active, but have not appreciably reduced 1965 broods. Intermittent logging and disposal of debris continued. Three 1965 blowdowns in mature spruce in the Pecos Wilderness, northwest of Las Vegas, were found to be lightly infested. The presence of the beetle in the blowdowns threatens the vast stands of mature spruce in both the Carson and Santa Fe National Forests. Two new blowdowns in the Pecos Wilderness, north of Pecos, were inspected, but no beetle attacks were evident.

Arizona five-spined ips, *Ips lecontei* Sw. Tree mortality from this ips increased suddenly in the young pine stands of central and north central Arizona. On Pinal Mountain, south of Globe, about 6,000 trees were killed; and about 8,000 in the Sierra Ancha Mountains, north of Globe. In the Copper Basin area, south of Prescott, Ariz., 600–800 trees were killed. This ips continued to disperse and infect ponderosa pine in east central Arizona. It was first collected at Point of Pines, on the San Carlos Indian Reservation, east of Globe.

Roundheaded pine beetle, *Dendroctonus adjunctus* (Blandf.). The two previously active infestations at Riggs Lake Recreation Area on Mt. Graham, near Safford, Ariz., and at Ruidoso, N. Mex., are at low endemic levels. At Riggs Lake, injection of cacodylic acid into infested trees reduced the broods and played a significant part in reducing the infestation.

Great Basin tent caterpillar, *Malacosoma fragile* (Stretch). This indigenous pest continued to decline throughout the Southwest. Populations active in the Pinal and Huachuca Mountains of southern Arizona in 1965 diminished to



F–516033

New Mexico Department of State Forestry officials observe the Douglas-fir tussock moth on ornamental blue spruce.

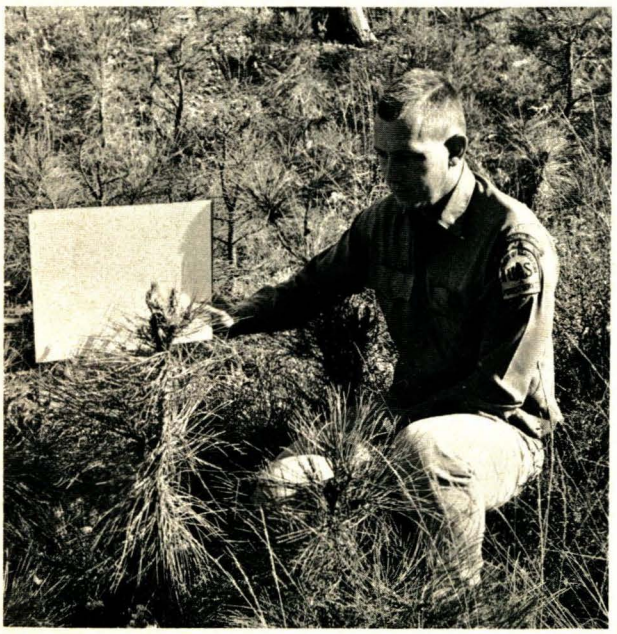
F–516034

Forest Service entomologist examines white fir needle miner damage.

very low levels. In northern New Mexico the small infestation centers continued to shift, but feeding was greatly reduced.

Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. On the Kaibab Plateau of northern Arizona, heavy mortality continued in several thousand acres of Douglas-fir type. Sustained epidemic has killed most of the mature trees; smaller diameter trees are now being attacked. In the Chuska Mountains of the Navajo Indian Reservation, north of Window Rock, Ariz., a new outbreak of this beetle has killed about 3,000 trees and threatens the entire stand of Douglas-fir. Logging of the dead trees has begun. At Mesa Verde National Park, Colo., infested Douglas-fir were treated by injection of cacodylic acid, resulting in 93 percent control of the infestation.

Southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar). Damage by this tip moth is more extensive and serious than originally estimated. Approximately 66,000 acres of natural reproduction and 2,000 acres of planted seedlings are infested. Infestation density ranges from 37 percent in seedlings planted in 1965 to 91 percent in seedlings planted in 1960. On natural regeneration, the infestation density ranges from 9 to 57 percent. Pilot tests to find a suitable chemical for control are planned for early 1967.



F–516035

The southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar), severely damaged terminals of ponderosa pine reproduction.

Nevada buck moth, *Hemileuca nevadensis Stretch.* This defoliator continued to strip native cottonwood at White Sands National Monument near Alamogordo, N. Mex. A pilot test with Thuricide 90 TS applied by mist blower at a 1:10 (1 part 90 TS to 9 parts water) dosage rate resulted in 97 percent mortality to 200 caged larvae. Of 200 check larvae, only one died. Plans are to continue maintenance control against this pest with Thuricide 90 TS.

Tussock moth, *Hemerocampa* sp. This unidentified tussock moth caused only light damage to boxelder seedlings at Whitewater Campground near Glenwood, N. Mex., in 1966. Control efforts using Carbaryl reduced the heavy populations to very low levels.

Fall webworm, *Hyphantria cunea* (Drury). After being endemic for 3 years following control in 1963, the webworm is causing moderate damage to native cottonwood and willow at Bandelier National Monument, near Los Alamos, N. Mex.

Pine engraver, *Ips pini* (Say). Several small infestations of this ips were observed throughout the Region. At Point of Pines on the San Carlos Indian Reservation east of Globe, Ariz., widespread killing of pole-size ponderosa occurred. For the first time, *Ips lecontei* has been found in association with this ips at Point of Pines; both were killing trees.

Seed and cone insects. A pine cone beetle, *Conophthorus scopulorum* Hopk., destroyed an estimated 47 percent of the already poor ponderosa pine cone crop on the Sacramento Division of the Lincoln National Forest. Additional damage was caused by a pine seed moth, *Laspeyresia* sp., and the pine seed chalcid, *Megastigmus albifrons* Wlk., each having infested about 13 percent of the cones. *M. albifrons* was also found infesting an estimated 93 percent of the pine cones collected from the Gila National Forest. The Douglas-fir seed chalcid, *Megastigmus spermatrophus* Wachtl, coneworms, *Dioryctria* sp., and a Douglas-fir cone moth, *Barbara colfaxiana* Kearf. (variety unknown) infested 24, 8, and 20 percent, respectively, of the Douglas-fir cones collected from the Gila National Forest. By comparison, damage to Douglas-fir in the Lincoln was light, being 3, 8, and 3 percent by the respective species.

F–516032

These San Carlos Apache Indian forestry workers are enclosing ips-infested ponderosa slash with clear plastic in an effort to kill the ips by solar heat.

Other insects. The fir engraver, *Scolytus ventralis* LeC., was active at very low levels throughout the Region. Populations of the Black Hills beetle, *Dendroctonus ponderosae* Hopk., in the Manzano Mountains south of Albuquerque, N. Mex., remain low in ponderosa and limber pine. Pure attacks by this beetle were not evident. Extensive mortality by the western balsam bark beetle, *Dryocoetes confusus* Sw., continued in stands of corkbark and alpine fir in New Mexico and northern Arizona. The pale tussock moth, *Halisidota tessellaris* (J. E. Smith), was active at a very low level on New Mexico alder at Whitewater Canyon near Glenwood, N. Mex. The grass plant bug, *Labops hesperius* Uhler, continues to reduce crested wheatgrass planted on rangeland. Life studies of this pest are being conducted on the Santa Fe National Forest near Cuba, N. Mex.

SOUTHERN AND SOUTHEASTERN STATES

By AMEL E. LANDGRAF, JR.,[1] Division of Forest Pest Control

Atlanta, Ga.

Conditions in Brief

Southern pine beetle populations remained at epidemic levels in Texas, Louisiana, Mississippi, and South Carolina. During 1966, land managers treated more than 159,000 infested trees and salvaged 370,000 others in the effort to reduce beetle populations to endemic numbers. Subzero temperatures in late January 1966 caused the serious southern pine beetle outbreak near Oak Ridge, Tenn., to collapse. Brood mortality was estimated at 99 percent.

Flooding and timber harvesting stimulated the rapid buildup of black turpentine beetle populations in Texas, Louisiana, and Mississippi. Losses were particularly heavy in east Texas and near Sulphur, La. During 1966, land managers treated over 165,000 trees and 55,000 stumps, and salvaged almost 14,000 trees to prevent more serious losses.

A midsummer drought caused *Ips avulsus* populations to reach epidemic numbers in the Carolinas and Arkansas.

The pales weevil continued to be a serious problem in the coastal area of North Carolina. Several thousand acres of planted stock have been badly damaged. Preliminary results indicate the weevil can be controlled by planting seedlings treated with DDT and then treating the planted area with granular DDT.

Several species of insects greatly reduced the volume of seed produced on seed orchards and seed production areas. As a result, land managers were unable to meet the demands for high-quality seed to reforest burned, cutover, and reclaimed lands.

The balsam woolly aphid continued to kill Fraser fir in ever-increasing numbers in North Carolina. Entomologists perfected a more sophisticated detection procedure that enables detection much earlier.

Damage by defoliating insects was more widespread and more severe than in 1965.

Status of Insects

Southern pine beetle, *Dendroctonus frontalis* Zimm. The southern pine beetle remains a serious problem in southeast Texas. High brood survival of fall generations caused renewed outbreaks. The Texas Forest Service and U.S. Forest Service treated more than 106,000 beetle-infested trees in 1966 to prevent outbreaks from increasing in size and intensity. This is almost twice the number of trees treated in 1965. The Yellowpine District, Sabine National Forest, experienced its first infestation, which fortunately disappeared.

In Louisiana, southern pine beetle infestations multiplied in East and West Feliciana, St. Helena, and East Baton Rouge Parishes. July surveys showed 41 infested trees per 1,000 acres, about four times the number found during a similar survey in April. Direct control by the Louisiana Forestry Commission reduced beetle populations in Allen and Calcasieu Parishes.

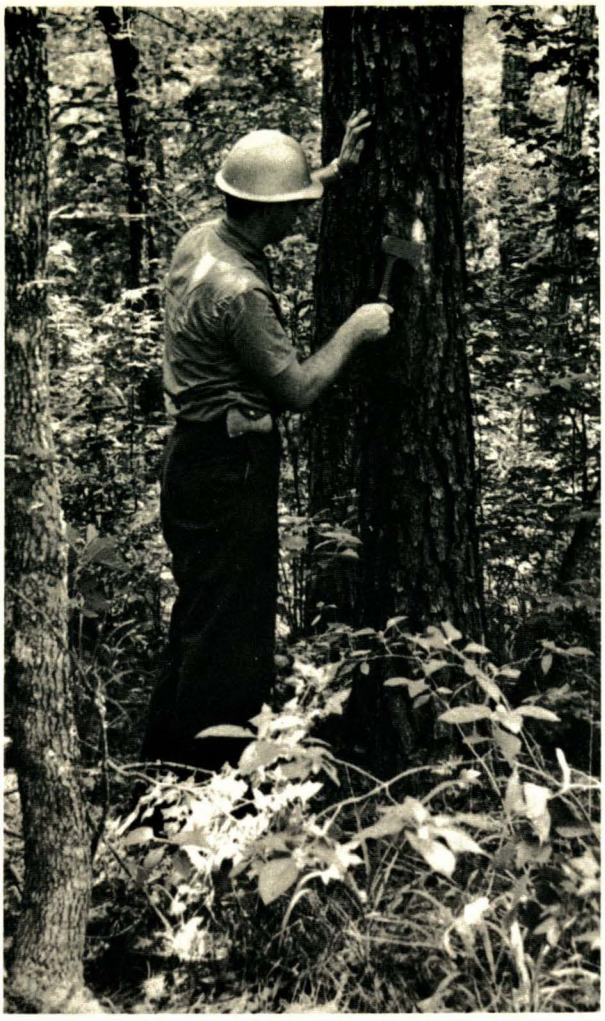
The southern pine beetle remained at epidemic levels in Mississippi during 1966 despite efforts to control it. An August survey showed 7.92 beetle-infested trees per 1,000 acres on the Homochitto National Forest. The most active infestations were found on private lands in Wilkinson and Amite Counties. Suppression efforts will be increased by the U.S. Forest Service and the Mississippi Forestry Commission in 1967.

A southern pine beetle outbreak occurred on the Francis Marion National Forest in South Carolina. By September, more than 4,300 trees had been killed. Most of the infested trees will be chemically treated or salvaged by March 1967.

A severe southern pine beetle outbreak near Oak Ridge, Tenn., collapsed. An estimated 99 percent of the overwintering brood was killed by subzero temperatures in late January 1966. As a result, the intensity of infestation dropped from 1,260 trees per 1,000 acres in January to less than one tree per 1,000 acres in August.

In central Alabama a southern pine beetle outbreak collapsed in January 1966 because of low temperatures.

[1] Report compiled from information submitted by Zone Offices at Asheville, N.C.; Macon, Ga.; Alexandria, La.; and State Pest Control personnel.



F–516051

The key to effective bark beetle suppression is locating and promptly removing trees infested by beetles.

An efficient salvage program reduced southern pine beetle activity in North Carolina. More than 302,000 infested trees were salvaged during 1966, bringing the total trees salvaged in the last 4 years to 1.1 million, valued at $1.4 million.

Southern pine beetle spots were discovered in 12 counties in Virginia. The State Forester reports that during the period of June 1, 1965, to May 31, 1966, bark beetles destroyed $932,000 worth of pulpwood and sawtimber, five times that of the previous reporting period.

Elsewhere in the Southeast, southern pine beetle populations were kept at low levels. Salvage and chemical suppression is being continued to further reduce losses.

Black turpentine beetle, *Dendroctonus terebrans* (Oliv.). The black turpentine beetle caused extensive damage throughout southeast Texas. Prolonged flooding of lowland areas, caused by blocked drainage ditches, was the greatest contributor to the buildup of beetle populations. Also, beetle populations built up in stands being harvested. Tree mortality was heaviest in Orange, Angelina, Liberty, Polk, and Trinity Counties.

The black turpentine beetle became a serious problem in logging areas near Sulphur, La. During 1966, the Kisatchie National Forest treated more than 90,000 trees and 55,000 stumps in order to keep beetle damage low.

In Mississippi, the black turpentine beetle continued to be a problem in cutover areas on the Homochitto, Bienville, and DeSoto National Forests. To prevent its increase, more than 49,000 trees were chemically treated in 1966.

Timber harvesting operations also caused a buildup of beetle populations on the George Washington National Forest, Va., and Cherokee National Forest, Tenn. Similar situations also occurred in Alabama, Arkansas, and Georgia.

Ips (pine engravers), *Ips* spp. Midsummer outbreaks of *Ips avulsus* (Eichh.) caused extensive damage to pine stands in the Piedmont areas of North and South Carolina. Infestations were particularly severe in Anson and Richmond Counties and Uwharrie National Forest, N.C. Localized outbreaks occurred around lightning strikes on the Daniel Boone National Forest, Ky. Heavy fall rains resulted in a sharp decline in beetle populations.

Extremely dry weather during early summer favored a rapid buildup of *Ips avulsus* populations in Arkansas. Many spots of 5 to 50 infested trees each were found on several Districts of the Ouachita National Forest.

In Alabama, Georgia, and Florida tree killing by *Ips* spp. was noticeable in stands adjacent to logged or burned areas.

Pales weevil, *Hylobius pales* (Hbst.). The pales weevil caused serious damage in new pine plantations in Alabama and Georgia and continued to do so in newly established plantations on private lands in eastern North Carolina. During 1966, Forest Service, State of North Carolina, and Riegel Paper Company personnel undertook a test to determine ways to reduce weevil damage. Four

F–516055

When possible, trees infested by bark beetles are salvaged.

thousand acres were planted with DDT-treated pine seedlings. The planted area was then treated with granular DDT. Preliminary observations are that this method is effective in reducing damage by weevils. The treated areas had less than 20 percent tree mortality, compared with over 60 percent mortality in the untreated areas.

Seed and cone insects. During 1966, land managers were unable to obtain enough high-quality seed from seed production areas and seed orchards to reforest burned, cutover, and reclaimed lands. Coneworms, seedworms, and other pests including cone beetles were primarily responsible for the insufficient supply of seed.

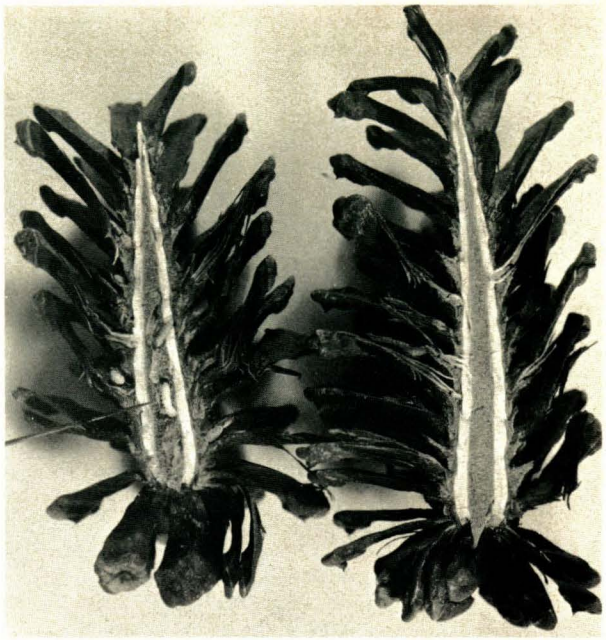
On the Francis Marion National Forest, S.C., about 70 percent of the cone crop was infested with the seedworm, *Laspeyresia ingens* Hein. Seed loss was estimated at 12 percent. An additional 3 percent of the cones were infested with coneworms, *Dioryctria amatella* (Hulst) and *D. clarioralis* (Wlk.).

F–516057

Black turpentine beetle infestations are readily identified by reddish pitch tubes at the base of trees.

In Louisiana and Texas, coneworm and seedworm damage was greater in longleaf seed production areas than in loblolly and shortleaf seed production areas.

A scolytid, *Pityophthorus pulicarius* (Zimm.), was found attacking first-year loblolly pine cones in South Carolina; and the coneworms *Dioryctria amatella*, *Eucosma* sp. near *cocana* Kearf. and the seedworm *Laspeyresia toreuta* (Grote) caused much damage in the seed production area in western North Carolina.



F–516046

Dissected slash pine cones are shown: *Left*, cones damaged by seedworms; *right*, undamaged cones.

Balsam woolly aphid, *Chermes piceae* Ratz. The balsam woolly aphid continued to ravage Fraser fir stands in North Carolina. In the Great Smoky Mountains National Park, local infestations were detected from Tri-Corner Knob to Mt. Sterling. Additional infestations were detected on Roan and Grandfather Mountains. The spruce-fir forests on the Balsam Mountains, N.C., and Mount Rogers National Recreation Area, Va., are still apparently free from aphid infestations.

A more sophisticated detection procedure was perfected by Forest Service entomologists. It consists of placing tanglefoot-coated microscope slides and wire screens at strategic points throughout tree stands to capture the mobile nymphs (Neosistens). Verification of aphids is by microscopic examination of traps. The procedure enables entomologists to detect an infestation 3 to 5 years earlier than possible with current methods.

Pine sawflies, *Neodiprion* spp. The loblolly-pine sawfly, *Neodiprion taedae linearis* (Ross), defoliated pine stands near Georgetown, La. Defoliation was heavier than reported in 1965. In Mississippi, 25 acres of young pine stands were heavily defoliated in 1966. This is the second reported occurrence of this insect in the State.

F–516045

A "cherry picker" aids in detecting and evaluating damage by seed and cone insects.

The red-headed pine sawfly, *Neodiprion lecontei* (Fitch), severely defoliated 2,000 acres of sapling-size shortleaf, longleaf, loblolly, and Virginia pine in Polk and Paulding Counties, Ga. Small local outbreaks occurred in Kentucky, North Carolina, and Virginia.

An outbreak of the Virginia pine sawfly, *Neodiprion pratti pratti* (Dyar), on the Daniel Boone National Forest, Ky., declined during 1966 because of a late spring frost at egg hatching time.

In Florida, an outbreak of the pine sawfly, *Neodiprion merkeli* Ross, severely defoliated 600 acres of sapling-size pine in Glades County. In Taylor County, a private landowner sprayed 200 acres to prevent this insect from causing additional damage to plantations.

Nantucket pine tip moth, *Rhyacionia frustrana* (Comst.). This insect continued to be a serious problem in seed orchards, nurseries, and pine plantations throughout the Southern and Southeastern States. So far, control results have been discouraging.

Forest tent caterpillar, *Malacosoma disstria* Hbn. Approximately 21,000 acres of tupelo gum in southwestern Alabama were heavily defoliated in 1966. This is almost twice the area defoliated in 1965. In Louisiana also, near Krotz Springs, several hundred acres of gum stands were heavily defoliated.

A leaf tier, *Croesia semipurpurana* (Kearf.). This leaf tier defoliated approximately 5,000 acres of scarlet oak near Covington, Va., and may be one of many causes of extensive mortality of scarlet oak in western Virginia.

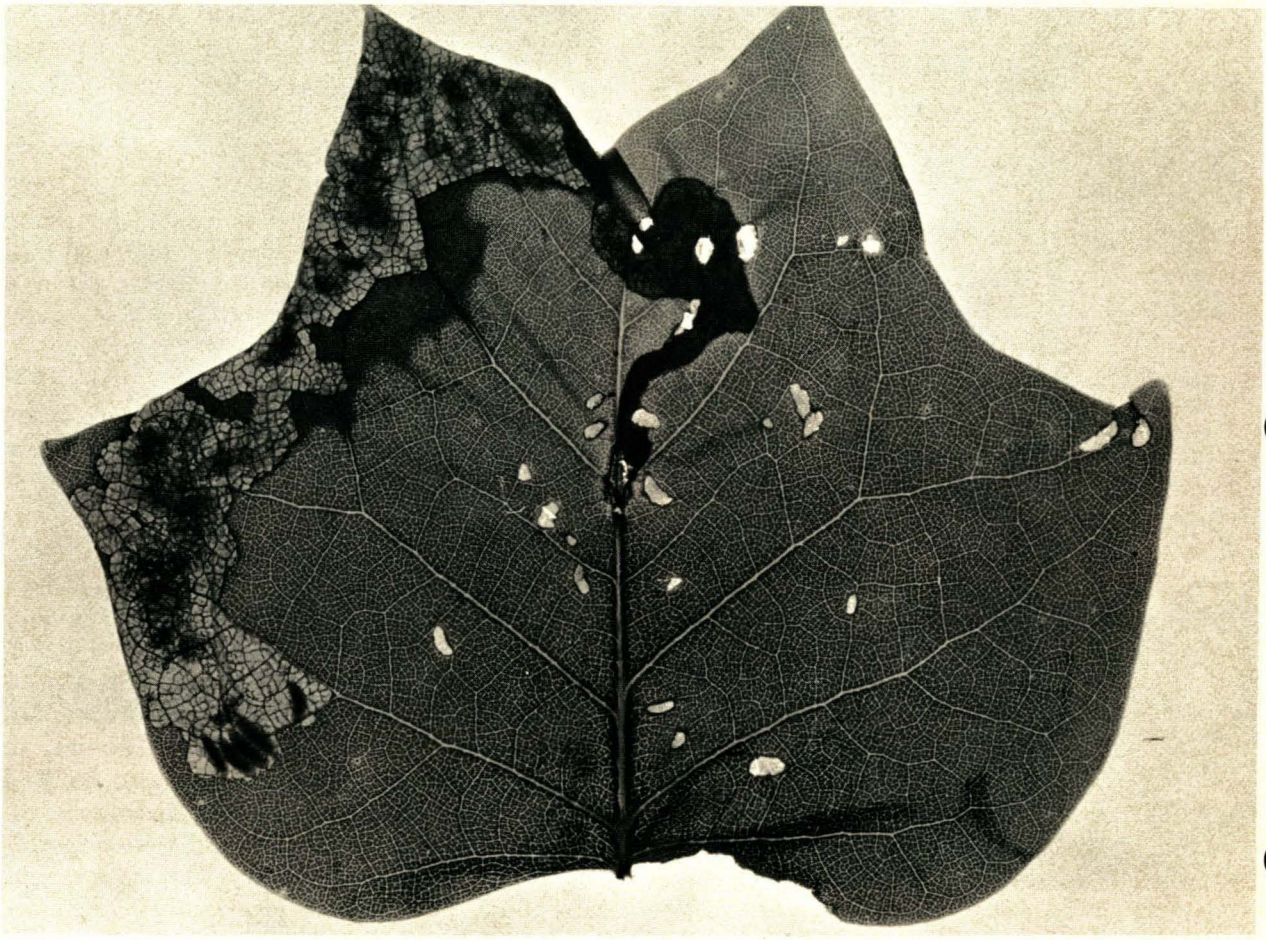
Other defoliators. In Virginia a looper, *Phigalea titea* (Cram.), which has been epidemic near Mt. Jackson since 1961, defoliated some 2,500 acres of hardwoods in 1966. Populations are declining owing to increased presence of a dipterous larval parasite. Two localized outbreaks of the fall cankerworm, *Alsophila pometaria* (Harris), in Bedford and Nelson Counties, Va., also declined during 1966. Egg parasitism by *Telenomus alsophilae* Vier., larval parasite, and a microsporidian disease were responsible. The eastern tent caterpillar, *Malacosoma americanum* (F.), severely defoliated cherry trees along roadsides in Kentucky. The puss caterpillar, *Megalopyge opercularis* (J. E. Smith), defoliated several thousand acres of turkey oak in a State forest in Citrus County, Fla. The fall webworm, *Hyphantria cunea* (Drury), caused heavy defoliation in Alabama and Arkansas during 1966. In Florida, an unidentified tussock moth defoliated 15,000 acres of water oak and laurel oak in Sumter and Hernando Counties.

The elm leaf beetle, *Galerucella xanthomelaena* (Schr.), and the larger elm leaf beetle, *Monocesta coryli* (Say), defoliated thousands of elms throughout the Piedmont area of Georgia and Alabama.

The cottonwood leaf beetle, *Chrysomela scripta* F., became a serious problem in plantations in Texas. During 1966, 1,314 acres of private plantations were treated in Liberty and Montgomery Counties in order to bring beetle outbreaks under control.

A leaf mining weevil, *Odontopus calceatus* Say, caused severe browning of yellow-poplar foliage in eastern Kentucky, southwestern Virginia, and northeastern Tennessee. The locust leaf miner, *Xenochalepus dorsalis* (Thunb.), caused some defoliation of black locust over extensive areas in Virginia, Kentucky, and Tennessee.

For the second consecutive year, the leaf beetle, *Glyptoscelis pubescens* (F.), defoliated Virginia, shortleaf, and white pine ramets in a U.S. Forest Service seed orchard near Murphy, N.C.



F–516060

This yellow-poplar leaf has been damaged by the leaf-mining weevil, *Odontopus calceatus*. Leaf mining is caused by the larvae. Rice-shaped holes result from adult feeding.

NORTHEASTERN STATES

By JAMES L. BEAN and VAUGHAN F. MCCOWAN,[1]

Northeastern Area - State and Private Forestry
Division of Forest Pest Control

Upper Darby, Pa.

Conditions in Brief

Defoliators continued to be the most troublesome forest insect pests. Extensive damage to several hundred thousand acres of oak in Connecticut, New Jersey, New York, and Pennsylvania has been caused by the oak leaf tier.

The spruce budworm appears to be declining in the upper Midwest, but is on the increase in Maine, where a control project is planned.

In Minnesota, Michigan, and Wisconsin defoliation by the jack-pine budworm is increasing in both area and intensity. Some control may be necessary.

The fall cankerworm has been active throughout West Virginia, New York, New Jersey, and Connecticut. It continued to be epidemic at some locations in northern Pennsylvania. Little or no control work is contemplated.

Such defoliators as the gypsy moth, forest tent caterpillar, pine sawflies, and hemlock looper generally decreased in number and activity or remained static.

Thousands of acres of red and scarlet oak have been severely damaged by the two-lined chestnut borer.

Other insects of some importance within the 20-State area are the white-pine weevil, white-pine shoot borer, balsam woolly aphid, red-pine scale, pine tip moths, pales weevil, birch leaf miner, Saratoga spittlebug, and the pine tortoise scale.

Status of Insects

Spruce budworm, *Choristoneura fumiferana* (Clem.). Heavy local defoliation occurred on the Superior National Forest, but otherwise the population declined in the upper Midwest. In Aroostook County, Me., approximately 140,000 acres of spruce-fir have been defoliated, and control work is planned by the State in 1967.

Jack pine budworm, *Choristoneura pinus* Free. Defoliation of jack pine by this insect was common in the Upper Peninsula and in the northern part of the Lower Peninsula of Michigan. Populations increased throughout northern Wisconsin and in northwestern Minnesota. The State of Wisconsin plans a suppression project on 30,000 acres in 1967.

Fall cankerworm, *Alsophila pometaria* (Harris). Populations of this insect remained at epidemic levels in Pennsylvania, spreading north, east, and west from locations in the north central part of the State. The insect has also become increasingly active in Connecticut, New Jersey, New York, and West Virginia. Suppression may be required in New Jersey to prevent further oak mortality.

Oak leaf tier, *Croesia semipurpurana* (Kearf.). Populations remained at high levels in New York, New Jersey, and Connecticut. In Pennsylvania and West Virginia infestations increased in size and intensity and are expected to continue at high levels in 1967. The Monongahela National Forest has 10,000 acres of oak stands suffering heavy mortality. An aerial application of Sevin on 1,500 acres is planned for 1967.

Forest tent caterpillar, *Malacosoma disstria* Hbn. There are scattered light infestations in northern Pennsylvania, and no changes are expected in 1967. In Maine and Vermont defoliation was light, but populations may increase slightly in 1967 with increased defoliation in a year or two. Epidemic numbers persist in the international border area of northern Minnesota from International Falls to the north of Ely and extending south to Crane and Echo Lakes. Scattered defoliation was reported on the Chippewa and Ottawa National Forests. Little spread is anticipated in 1967, but the damage may be more intense.

Larch sawfly, *Pristophora erichsonii* (Htg.). Defoliation in Pennsylvania generally decreased except for a few small areas in the western part of the State. A heavy infestation on the Allegheny National Forest is to be treated with malathion in 1967. Heavy damage was reported in southwestern New York, but populations declined elsewhere in the State. Heavy defoliation con-

[1] From information submitted by the Zone Leaders at Amherst, Mass.; Delaware, Ohio; Milwaukee, Wis.; and State Pest Control personnel.

tinued in eastern Maine, and isolated, small populations were detected in Vermont and New Hampshire.

Balsam woolly aphid, *Chermes piceae* Ratz. This insect is found in Maine, New Hampshire, Vermont, and New York. Fir mortality is continuing steadily, and gouting of young trees is common. Populations are apparently static over most of New England except in New Hampshire, where 3,000 acres in Coos County are infested.

Saratoga spittlebug, *Aphrophora saratogensis* (Fitch). Scar count surveys generally indicate small populations throughout Michigan, Minnesota, and Wisconsin. Spittlebugs have caused flagging and top kill of red pine on the Red Lake Indian Reservation and the Nicolet and Chequamegon National Forests. To prevent further damage on these areas, it may be necessary to treat 600 acres with malathion.

Red-headed pine sawfly, *Neodiprion lecontei* (Fitch). Scattered infestations were reported in Upper Michigan, New Hampshire, Vermont, and Wisconsin. Many plantations in New York have suffered heavy damage from this insect, and the populations continue high. Vermont also reports high populations. Jack pine was severely defoliated along roads in central Minnesota, but this was not considered the portent of a major outbreak.

White-pine weevil, *Pissodes strobi* (Peck). Light to moderate damage in plantations of white, red, and jack pine and white spruce was reported throughout the Lake States. Weevil populations are static in this area. In Maine, New Hampshire, and New York damage is heavy and populations appear to be increasing. Methods for evaluating weevil damage to determine when control work is needed will continue to be studied in 1967.

Pine tortoise scale, *Toumeyella numismaticum* (P. & M.). This insect continues to be a problem in Wisconsin in Christmas tree plantings and natural jack pine stands. Tree mortality is common on understory and open-grown trees in the jack pine areas. Populations are static.

Pine engraver beetles, *Ips* spp. Engraver beetle activity increased substantially in the Huron-Manistee National Forest area. The most damage occurred where pine stands had been thinned. Damage to residual trees was most severe where pulpwood had been piled and kept from the summer of 1965. Scattered pockets of engraver beetles were also found in stands heavily defoliated by the jack pine budworm.

Pine tussock moth, *Dasychira plagiata* (Wlk.). Moth activity widened and intensified on 12,000 acres in Douglas County, Wis., where previous outbreaks had occurred. A further increase is expected in 1967. Serious damage is not anticipated from the tussock moth alone, but considerable tree mortality may result from a combined attack by the tussock moth and jack pine budworm.

Gypsy moth, *Porthetria dispar* (L.). Infestations collapsed in Massachusetts, New Hampshire, Vermont, and Connecticut. In New York 219,124 acres were successfully treated with carbaryl, and *Bacillus thuringiensis* was pilot tested on 1,000 acres.

Brown-tail moth, *Nygmia phaeorrhoea* (Don.) Small infestations were found on the Cape Cod National Seashore and on two islands off Falmouth, Me. Indications are that the insect will increase moderately in 1967. Control operations, using carbaryl, were carried out in some recreation areas.

Larch casebearer, *Coleophora laricella* (Hbn.). This insect is found in most larch stands throughout New England and New York. Populations are particularly heavy in Cortland County, N.Y. Generally, populations are static, owing to control by a complex of parasites.

White-pine shoot borer, *Eucosma gloriola* (Perg.). This insect has been reported from most areas in New England and New York, with the heaviest infestations on Scotch and white pines in New York. Techniques for detection and evaluation of this insect are being developed.

Birch leaf miner, *Fenusa pusilla* (Lep.). Heavy and extensive defoliation of gray and white birch in New England and northern New York was reported. The insect will probably remain at outbreak levels in 1967.

Yellow-headed spruce sawfly, *Pikonema alaskensis* (Roh.). This insect is becoming a problem on roadside and plantation spruce in the Lake States, New England, and New York. It has caused some tree mortality in young plantations. Not enough information is available on the insect to determine population trends.

European pine sawfly, *Neodiprion sertifer* (Geoff.). In Ohio the population is increasing, with the heaviest infestation in the northern half

of the State. Several areas of light and heavy infestations were found in Illinois and Pennsylvania; additional population increases are expected in 1967. Populations of various intensities have been found in New Jersey, New York, and New England. Reports indicate an increase in damage by this insect in 1967. In all areas, red and Scotch pines were the preferred hosts.

Beech scale, *Cryptococcus fagi* (Baer.). This was reported in New York, Vermont, Massachusetts, Maine, and New Hampshire. It and its fungus associate (*Nectria*) have been found in most areas where beech grows commercially. Harvesting infested trees and opening stands have not reduced the populations to tolerable levels.

Maple scale, *Cryptococcus* sp. This insect was recently found on sugar maple in New Hampshire and Vermont. It has probably been present for many years, as it is widely distributed over both States. To date, its taxonomic status is not firm.

Red pine scale, *Matsucoccus resinosae* B. & G. This insect is found only in New Jersey, New York, and Connecticut, where it is killing many red pines. A special survey is being conducted to determine the extent of the infested area.

Two-lined chestnut borer, *Agrilus bilineatus* (Web.). This pest is killing red and scarlet oak on thousands of acres in Pennsylvania and West Virginia where drought, frost, and leaf tiers have weakened the trees. Further increases in oak mortality are expected in 1967.

Miscellaneous insects. Populations of the pine leaf aphid, *Pineus pinifoliae* (Fitch), have declined throughout the entire area this year. Throughout the Northeast and Lake States the introduced pine sawfly was reported on white, Scotch, and red pines. In Missouri, the black turpentine beetle caused scattered mortality in plantations. The Virginia pine sawfly, *Neodiprion pratti pratti* (Dyar), was found near Athens, Ohio; but is on the wane in Illinois and West Virginia.

INDEX

	Page
Acleris variana (Fern.)	7, 12, 23
Agathis pumila (Ratz.)	22
Agrilus bilineatus (Web.)	39
Alaska spruce beetle	8
Alsophila pometaria (Harris)	35, 37
Ambrosia beetles	7, 8
Anacamptodes clivinaria (Guenee)	19
Aphrophora saratogensis (Fitch)	38
Argyrotaenia spp	18
Arizona five-spined ips	5, 27, 28
Aspen leaf tier	19
Balsam woolly aphid	5, 6, 10, 31, 34, 37, 38
Barbara colfaxiana Kearf	29
Bark weevil	22
Beech scale	39
Birch leaf miner	37, 38
Black-headed budworm	4, 7, 12, 21, 23
Black Hills beetle	6, 24, 27, 30
Black turpentine beetle	5, 6, 31, 32, 39
Bondia sp	14
Brachyrhinus ovatus (L.)	12
Brown tail moth	38
Bud mites	12
California flatheaded borer	14
California oakworm	14
Casebearer	14
Cecidomyia piniinopis (O. S.)	15
Cedar bark beetle	8
Chermes piceae Ratz	34, 38
Choristoneura conflictana (Wlk.)	7, 19
Choristoneura fumiferana (Clem.)	17, 22, 24, 27, 37
Choristoneura lambertianae (Busck)	18
Choristoneura pinus Free	18, 37
Chrysomela scripta F	9, 36
Coleophora sp	14
Coleophora laricella (Hbn.)	9, 22, 38
Coleotechnites sp	10, 14
Coleotechnites milleri (Busck)	14
Coloradia lindsayi B. & B	14
Coloradia pandora Blake	12, 14
Cone beetles	33
Cone moths	9
Coneworm	29, 33, 34
Conophthorus scopulorum Hopk	29
Cottonwood leaf beetle	9, 36
Croesia semipurpurana (Kearf.)	35, 37
Cryptococcus sp	39
Cryptococcus fagi (Baer.)	39
Cylindrocopturus eatoni Buch	15
Dasychira sp	23
Dasychira plagiata (Wlk.)	38
Dendroctonus adjunctus (Blandf.)	28
Dendroctonus brevicomis LeC	11, 13, 18, 22
Dendroctonus frontalis Zimm	31
Dendroctonus obesus (Mann.)	8, 11, 18, 24, 2
Dendroctonus ponderosae Hopk	12, 13, 17, 21, 24, 26, 30
Dendroctonus pseudotsugae Hopk	11, 12, 18, 22, 29
Dendroctonus terebrans (Oliv.)	32
Dendroctonus valens LeC	14, 19
Dioryctria sp	29
Dioryctria abietella (D. & S.)	15
Dioryctria amatella (Hulst)	33, 34
Dioryctria clarioralis (Wlk.)	33
Douglas-fir beetle	4, 5, 6, 11, 12, 17, 18, 22, 26, 27, 29
Douglas-fir cone moth	29
Douglas-fir seed chalcid	29
Douglas-fir tussock moth	6, 10, 19, 24, 25, 27
Dryocoetes confusus Sw	30
Eastern tent caterpillar	35
Elatobia martinella Wlk	1
Elm leaf beetle	36
Engelmann spruce beetle	4, 5, 11, 18, 24, 27, 28
Engelmann spruce weevil	22
Epinotia sp	14
Epinotia meritana Hein	19, 28
Eucosma sp	34
Eucosma gloriola (Perg.)	38
European pine sawfly	38
European pine shoot moth	9, 12, 14
Fall cankerworm	5, 6, 35, 37
Fall webworm	14, 29, 35
Fenusa pusilla (Lep.)	38
Fir coneworm	15
Fir engraver	11, 13, 30
Fir needle miner	1
Flatheaded fir borer	14
Forest tent caterpillar	5, 35, 37
Galerucella xanthomelaena (Schr.)	36
Glyptoscelis pubescens (F.)	36
Gouty pitch midge	15
Grass plant bug	19, 30
Great Basin tent caterpillar	24, 26, 28
Gypsy moth	5, 37, 38
Halisidota ingens Edws	25
Halisidota tessellaris (J. E. Smith)	30

	Page
Hemerocampa sp	19, 29
Hemerocampa pseudotsugata McD	10, 14, 19, 25, 27
Hemileuca nevadensis Stretch	29
Hemlock looper	37
Hemlock sawfly	4, 6, 7, 10
Hilarographa regalis (Wlsm.)	14
Hylobius pales (Hbst.)	32
Hyphantria cunea (Drury)	14, 29, 35
Introduced pine sawfly	39
Ips spp	13, 18, 32, 38
Ips avulsus (Eichh.)	31
Ips lecontei Sw	28, 29
Ips pini (Say)	11, 22, 27, 29
Jack-pine budworm	5, 6, 37
Jeffrey pine beetle	4, 12
Labops hesperius Uhler	19, 30
Lambdina fiscellaria lugubrosa (Hulst)	8, 10
Lambdina fiscellaria somniaria (Hulst)	10
Larch bud moth	4, 21, 23
Larch casebearer	4, 9, 21, 22, 38
Larch sawfly	4, 10, 21, 23, 37
Large aspen tortrix	7, 19
Larger elm leaf beetle	36
Laspeyresia sp	29
Laspeyresia ingens Hein	33
Laspeyresia miscitata Hein	15
Laspeyresia toreuta (Grote)	34
Leaf beetle	36
Leaf-mining weevil	36
Leaf tier	4, 7, 35
Loblolly-pine sawfly	34
Locust leaf miner	36
Lodgepole needle miner	14
Lodgepole pitch borer	23
Looper	5, 17
Malacosoma spp	14, 19
Malacosoma americanum (F.)	35
Malacosoma disstria Hbn	35, 37
Malacosoma fragile (Stretch)	26, 28
Maple scale	39
Matsucoccus resinosae B. & G	39
Mealybug	21
Megalopyge opecularis (J. E. Smith)	35
Megastigmus albifrons Wlk	29
Megastigmus spermotrophus Wachtl	29
Melanophila californica Van Dyke	14
Melanophila drummondi (Kby.)	14
Monocesta coryli (Say)	36
Mountain pine beetle	4, 6, 9, 13, 17, 21
Nantucket pine tip moth	35
Needle miner	4, 9, 14
Neodiprion sp	10, 12, 34
Neodiprion abietis complex (Harris)	14
Neodiprion edulicolus Ross	19
Neodiprion lecontei (Fitch)	35, 38
Neodiprion merkeli Ross	35
Neodiprion pratti pratti (Dyar)	39
Neodiprion sertifer (Geoff.)	38
Neodiprion taedae linearis (Ross)	34
Neodiprion tsugae Midd	7
Nepytia freemani Monroe	19
Nepytia phantasmaria (Strecker)	14
Nevada buck moth	27, 29
Nygmia phaeorrhoea (Don.)	38
Oak leaf tier	37
Odontopus calceatus Say	36
Oregon pine ips	11
Pale tussock moth	30
Pales weevil	5, 6, 31, 32, 37
Pandora moth	12, 14
Petrova edemoidana (Dyar)	14
Phantom hemlock looper	14
Phigalia titea (Cram.)	35
Phloeosinus squamosus Blkm	8
Phryganidia californica Pack	14
Pikonema alaskensis (Roh.)	38
Pine cone beetle	29
Pine engraver	13, 18, 22, 27, 29, 32
Pine leaf aphid	39
Pine needle miner	10
Pine needle sheath miner	4, 14, 18, 21, 23
Pine sawfly	5, 34, 35, 37
Pine seed chalcid	29
Pine seed moth	15, 29
Pine tip moth	14, 37
Pine tortoise scale	37, 38
Pine tussock moth	4, 21, 23, 38
Pineus pinifoliae (Fitch)	39
Pissodes sp	19
Pissodes curriei Hopk	22
Pissodes engelmanni Hopk	22
Pissodes sitchensis Hopk	9
Pissodes strobi (Peck)	38
Pitch mass borers	21
Pitch moths	14
Pityophthorus pulicarius (Zimm.)	34
Porthetria dispar (L.)	38
Pristiphora erichsonii (Htg.)	10, 23, 37
Pseudohazis sp	19
Pseudohylesinus spp	11
Puss caterpillar	35
Puto sp	21
Red-headed pine sawfly	6, 35, 38
Red-pine scale	37, 39
Red turpentine beetle	14, 19
Reproduction weevil	15
Retinodiplosis inopis (O. S.)	15
Rhyacionia buoliana (Schiff.)	14

	Page
Rhyacionia frustrana (Comst.)	35
Rhyacionia neomexicana (Dyar)	29
Rhyacionia zozana (Kearf.)	14
Roundheaded pine beetle	27, 28
Saratoga spittlebug	6, 37, 38
Satin moth	14
Sawflies	19
Sciaphila duplex (Wlsm.)	19
Scolytus ventralis LeC	11, 13, 30
Seedworm	33, 34
Sequoia pitch moth	14
Sheep day moth	19
Silver fir beetle	11
Sitka spruce beetle	4
Sitka-spruce weevil	9
Southern pine beetle	5, 6, 31
Southwestern pine tip moth	5, 27, 29
Spider mite	12
Spruce bark beetle	7
Spruce budworm	4, 5, 6, 16, 17, 21, 22, 23, 24, 27, 37
Steremnius carinatus (Boh.)	9
Stilpnotia salicis (L.)	14
Strawberry root weevil	12
Sugar pine tortrix	5, 17, 18
Tent caterpillars	14, 17, 19
Telenomus alsophilae Vier	35
Tiger moth	24, 25
Toumeyella numismaticum (P. & M.)	38
Tussock moths	14, 19, 27, 29, 35
Two-lined chestnut borer	37, 39
Vespamima sp	23
Vespamima sequoiae (Hy. Edw.)	14
Virginia pine sawfly	35, 39
Wasp	22
Weevil	19
Western balsam bark beetle	30
Western hemlock looper	7, 8
Western oak looper	10
Western pine beetle	4, 6, 11, 12, 13, 18, 22
White-fir looper	19
White-fir needle miner	5, 19, 28
White-fir sawfly	14
White-pine shoot borer	37, 38
White-pine weevil	6, 37, 38
Xenochalepus dorsalis (Thunb.)	36
Xyela radiatae Burdick	15
Xyelid sawfly	15
Yellow-headed spruce sawfly	38
Zeiraphera griseana (Hbn.)	23
Zelleria haimbachi Busck	14, 18, 23

U.S. GOVERNMENT PRINTING OFFICE: 1967 O—256-077